P-32+ and P-32 System

TOPCON

Operator's Manual

P-32+ and P-32
Operator's Manual

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Manual Conventions

This manual uses the following conventions:

Convention	Description	Example
Bold	Menu, or drop-down menu selection	**File ▸ Exit** (Click the **File** menu and click **Exit**)
	Name of a dialog box or screen	From the **Connection** screen...
	Button or key commands	Click **Finish**.
`Mono`	User supplied text or variable	Type `guest`, and click **Enter.**
Italic	Reference to another manual or help document	Refer to the *Topcon Quick Guide.*

Further information to note about system configuration, maintenance, or setup.

Supplementary information that can have an adverse effect on system operation, system performance, data integrity, measurements, or personal safety.

Notification that an action has the potential to result in system damage, loss of data, loss of warranty, or personal injury.

System Overview

Your Topcon P-32+ and P-32 Systems are complete, non-contacting control systems which combine both elevation control and slope control into a simple, easy to use package (Figure 1).

The primary function of the Topcon P-32+ and P-32 Systems are to provide screed control so that the paving material is placed into position at the correct elevation and slope.

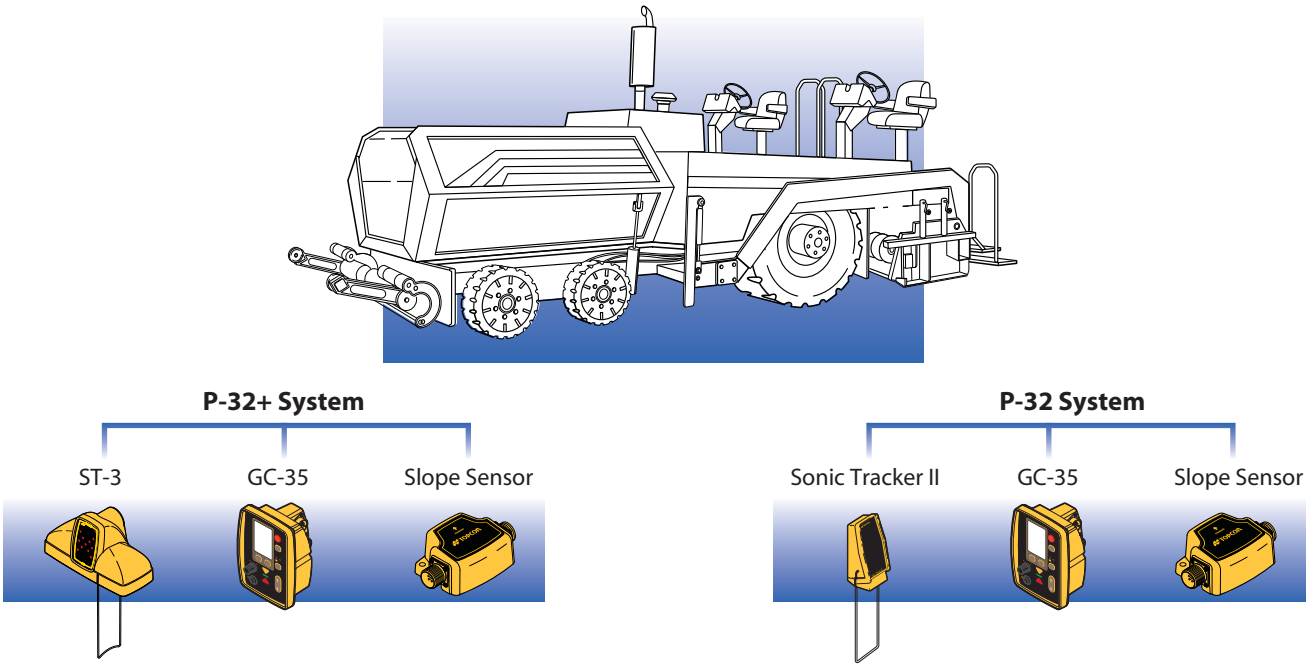
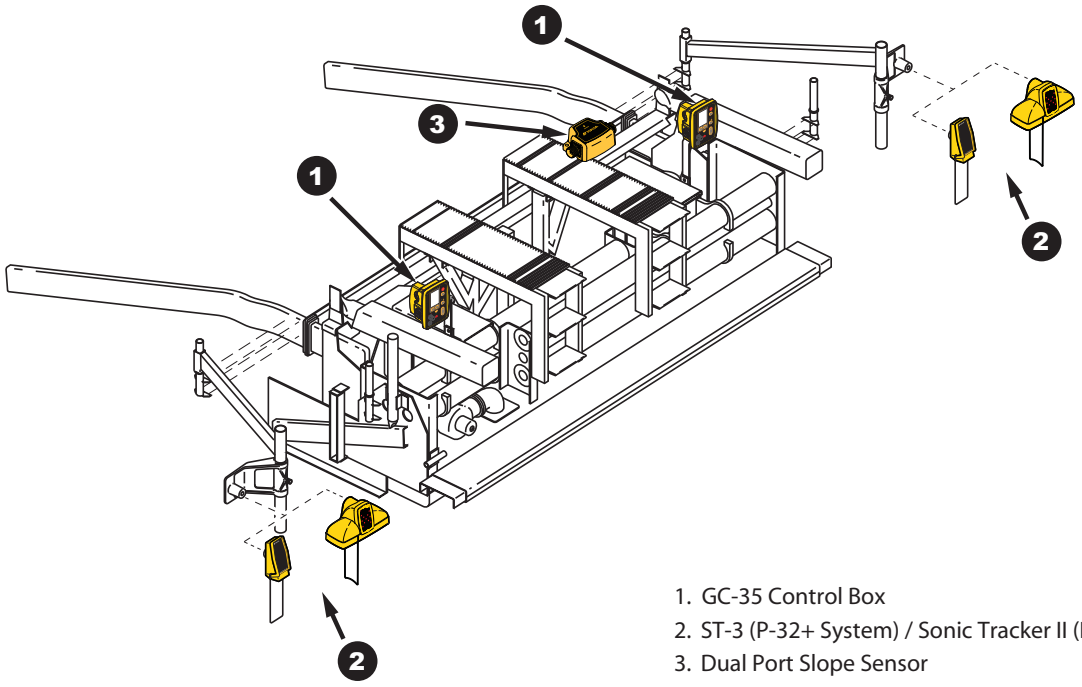


Figure 1: Topcon P-32+ and P-32 System Components

Figure 2 displays the setup of the P-32+ and P-32 System components on a screed.



1. GC-35 Control Box
2. ST-3 (P-32+ System) / Sonic Tracker II (P-32 System)
3. Dual Port Slope Sensor

Figure 2: Topcon P-32+ and P-32 System on Screed

Getting Acquainted

Standard Topcon P-32+ and P-32 Systems include two Control Boxes, two Sonic Trackers (ST-3 for P-32+ and Sonic Tracker II for P-32) and a single Dual Port Slope Sensor. When setup and connected, the Control Boxes control either the left or right side of the machine for either elevation or slope.

GC-35 Control Box

The GC-35 Control Box (Figure 3) is the operator's interface to the Topcon P-32 System. The Control Box receives signals from the sensors (Sonic Tracker, Laser Tracker, and/or Slope Sensor), and uses these signals to determine if grade or slope corrections are necessary. If a change in grade or slope is required, the Control Box sends a signal to the valve controlling the tow point cylinder on the appropriate side of the machine to raise or lower, thus maintaining correct mat thickness.

The Control Box connects to the Sonic Tracker, the Slope Sensor, and to the paver through electrical cables. The Control Box easily attaches to its mounting bracket with one clamp, and at the end of the day should be removed for storage.

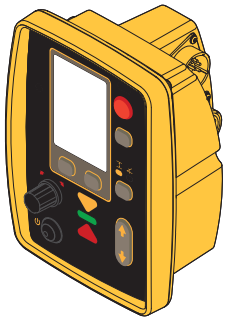
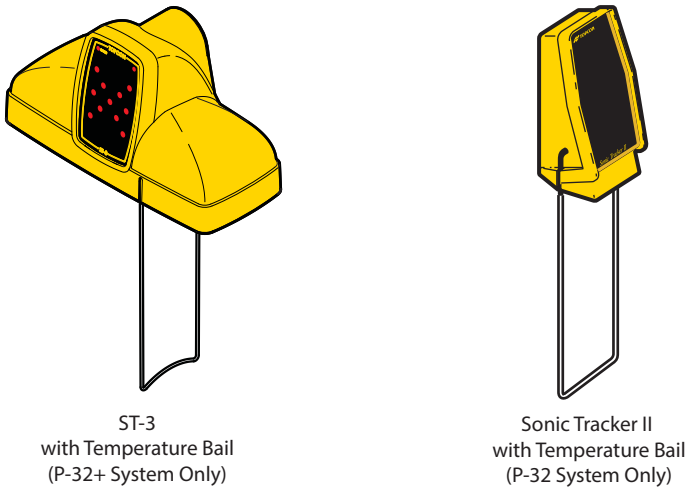


Figure 3: Control Box

Sonic Tracker

Whether you are using the ST-3 (P-32+) or the Sonic Tracker II (P-32), the Sonic Tracker (Figure 4) measures and controls the elevations of the screed. A transducer(s), located in the bottom of the Sonic Tracker, generates sound pulses like a speaker and listens for returned echoes like a microphone. The Tracker measures the distance, and controls grade from a physical grade reference, such as a curb, stringline, or existing road surface. A bail is used to compensate for rapid air temperature changes. In paving applications a bail should always be used.

The Sonic Tracker attaches to the system through one quick connect cable and attaches to the machine with a single bolt. At the end of the day, Sonic Tracker should be removed for proper storage in the carrying case.



ST-3
with Temperature Bail
(P-32+ System Only)

Sonic Tracker II
with Temperature Bail
(P-32 System Only)

Figure 4: ST-3 and Sonic Tracker II

Dual Port Slope Sensor

The Dual Port Slope Sensor (Figure 5) is a precision electronic sensor which functions much like a precision carpenter's level. The Slope Sensor reads the inclination (tilt) of the screed and sends the signal to the Control Box. The Slope Sensor measures slopes from +20% to -20%.

The Slope Sensor connects to each Control Box through an electrical cable and requires no adjustments, and is the only component of your Topcon P-32 System that can be used to control either side of the paver. The Slope Sensor is a sealed component, and once attached to the Paver, should not be removed.

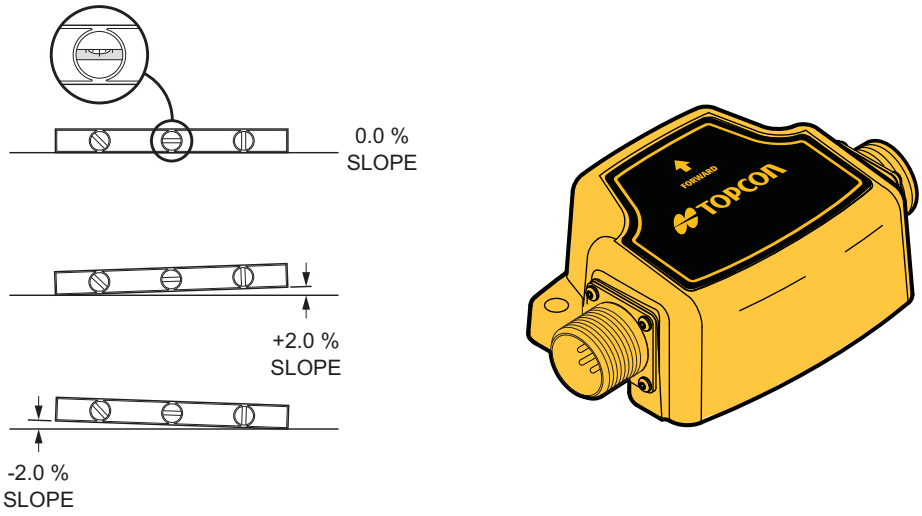


Figure 5: Dual Port Slope Sensor

Smoothtrac Sonic Averaging System (Optional Add-on System)

The Smoothtrac® Sonic Averaging System (SAS) (Figure 6) is an optional add-on elevation control system that combines multiple Slope Sensors to calculate an average of the physical reference. Each tracker sends its distance measurement to the Control Box which then averages those measurements and sends a correction signal to the tow point cylinder. The Smoothtrac replaces the mechanical ski that drags on the ground. The Smoothtrac connects to the Control Box through the tracker cable.

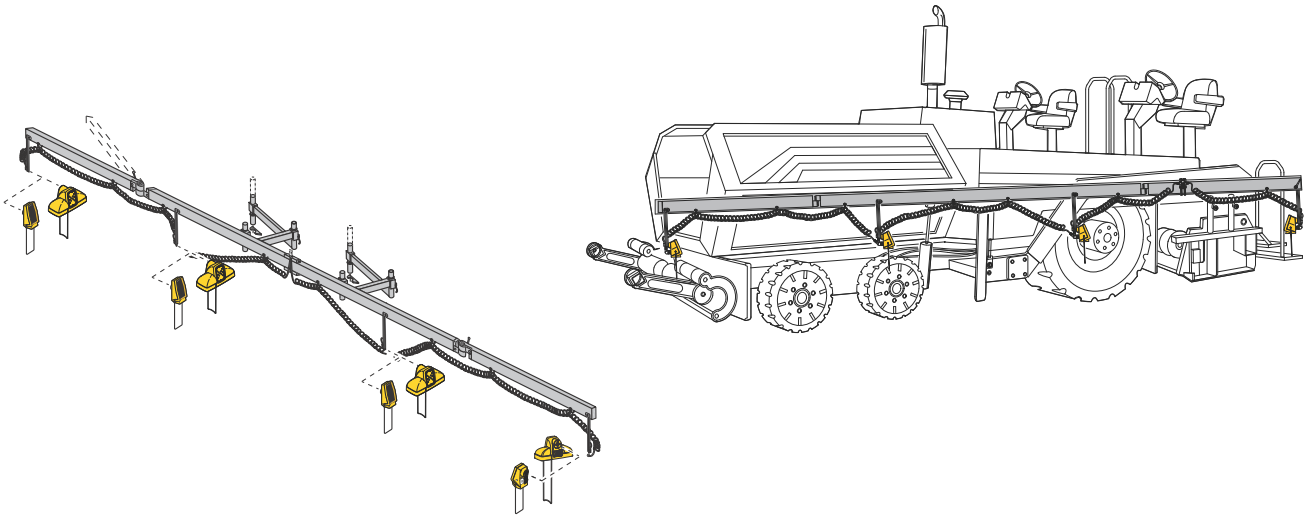


Figure 6: Optional Smoothtrac Sonic Averaging System (SAS)

Laser Receiver (Optional Add-on Component)

The Laser Receiver (Figure 7) is an optional add-on elevation control sensor that measures and controls the elevation of the screed. After receiving a signal from a rotating laser, the Laser Receiver sends a signal to the Control Box, which then sends a raise or lower signal to the tow point cylinder. The TrackerJack attaches to the Laser Receiver and then mounts to a vibration pole. Use the same cable from the Sonic Tracker to power the Laser Receiver TrackerJack system.
The Laser Receiver should be removed at the end of each day and stored in its carrying case.

Figure 7: Optional Laser Receivers

Carrying Case

Topcon provides a Carrying Case (Figure 8 and Figure 9) with your system. The case includes cutouts that fit the components.

Figure 8: P-32+ System Carrying Case

Figure 9: P-32 System Carrying Case

This chapter describes the components of pavers and the basics in paving principles, as well as control methods used for paving.

Paver Components

Modern pavers (Figure 10) consist of two major units: the Tractor and the Screed.

The primary function of the tractor is to propel the truck or paver feeding device, to convey and distribute the paving material and to tow the screed. The function of the screed is to strike off the material in preparation for further compaction. The screed is mounted to the tow arms at the screed pivot points and is attached to the paver at the tow points.

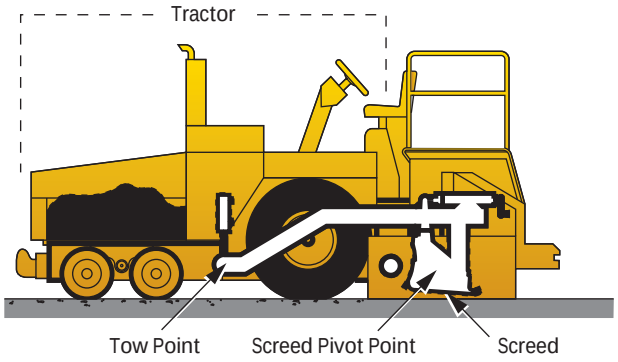


Figure 10: Paver Components

How a Screed Works

The screed on all modern pavers is of the “floating, self leveling” type. As the paver tows the screed unit forward, paving material flows under the screed. This causes the screed to float on the mat of material, thus establishing mat thickness. Since the screed is mounted to the paver only at the tow points, the screed is completely free to float up or down (Figure 11). The screed always seeks it's own “Planing Angle”, or angle of attack, dependent on the combination of forces acting upon the screed.

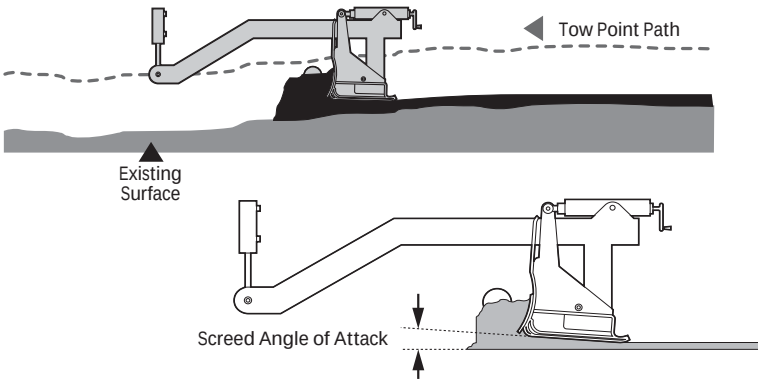


Figure 11: Tow Point Path and Planning Angle

- If the screed angle of attack is increased the screed rises, increasing the mat thickness (Figure 12).
- If the angle of attack is decreased, the screed settles, providing a thinner mat surface (Figure 12).

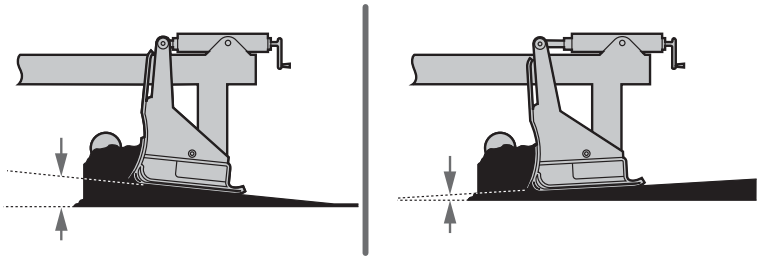


Figure 12: Screed Determines Mat Thickness

Because the screed floats, it does not immediately react to a change in the tow point. It needs a certain amount of time or distance to make a correction in the mat thickness (Figure 13).

- If the tow point is changed by a unit of one, the paver must move one tow arm length before the screed corrects 63% of the elevation.
- After 2 tow arm lengths 83% of the correction is made and 3 tow arm lengths would account for 95%.
- It takes 6 tow arm lengths to achieve 100% of the elevation change.

Considering that 95% of the change takes place after 3 tow arm lengths, this can be used in practical applications to qualify for full correction.

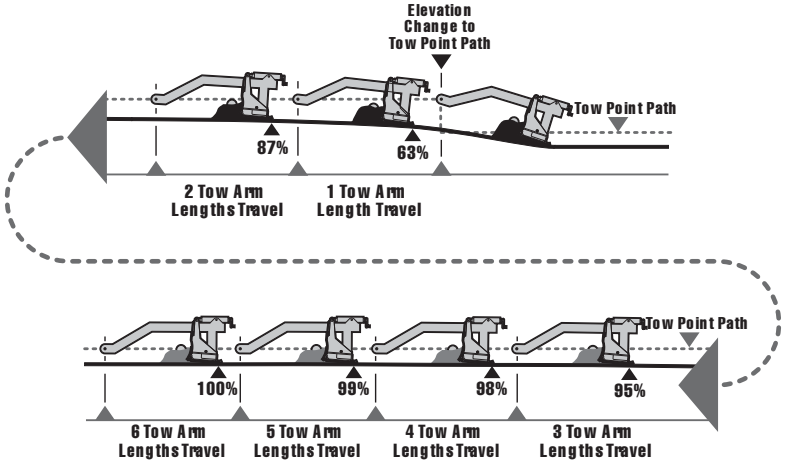


Figure 13: Tow Arm Travel

The same is true when making elevation changes with the manual thickness cranks (Figure 14).

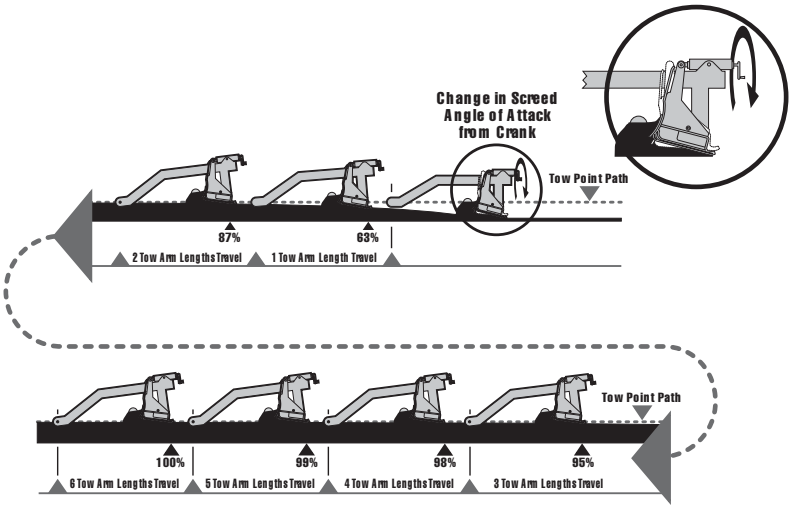


Figure 14: Manually Changing Mat Thickness

Avoid cranking while in Auto mode and keep the left and right rotation the same.

Always check mat depth in several locations before making any elevation corrections. The surface being paved may have wheel ruts, dips and ridges that gives an untrue indication of overall mat depth. Check several spots to get an average (Figure 15). If an elevation change is made, wait 3 tow arm lengths for full correction. Too many set point changes and stabbing causes raise and lower changes that produces an uneven mat surface.

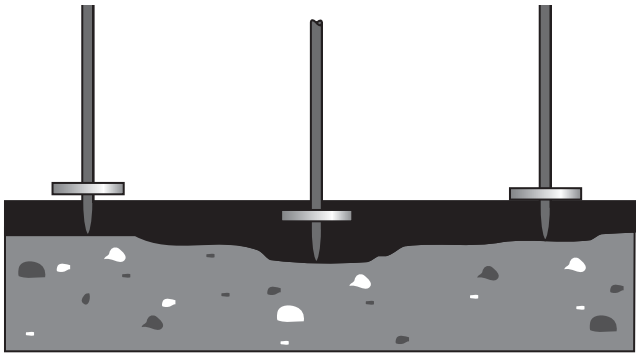


Figure 15: Checking Mat Thickness

The screed has four main forces acting on it at all times, whether paving in manual or with automatics (Figure 16). A change in any one of the forces causes the screed to rise or fall, changing the mat depth. The key to smoother paving is to keep these forces as constant as possible. The following sections review these forces and the factors that have an effect on paving.

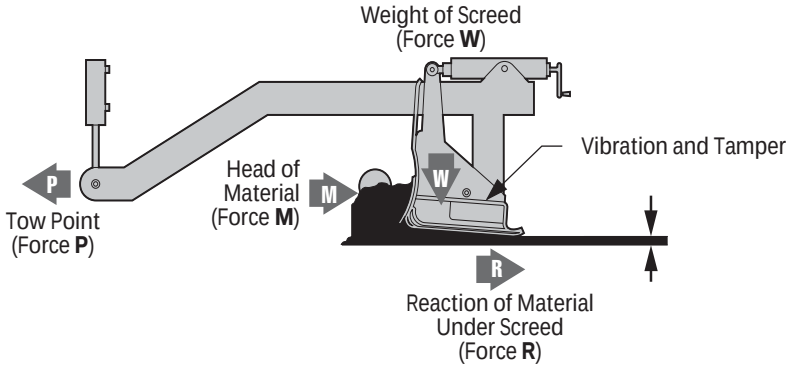


Figure 16: Forces Affecting the Screed

Tow Point Force (P)

The tow point force (**P**) is the resistance to forward travel (Figure 17).

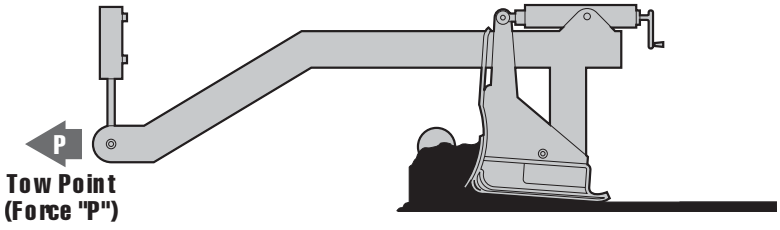


Figure 17: Tow Point Force (P)

The **P** force remains constant if the paver is kept moving at a consistent speed at all times. If the paver is allowed to stop, the screed settles in the fresh mat and leaves a mark. The mark cannot be fully smoothed out by the roller and a bump ends up in the mat that shows up in the profilograph readings. Changing the speed of the paver also causes the screed to rise and fall, affecting mat thickness.

The optimum paving speed is determined by the depth and width being paved and the rate at which material can be delivered to the job. Calculate the tons/hour into feet per minute (Figure 18). Do not start and stop the paver.

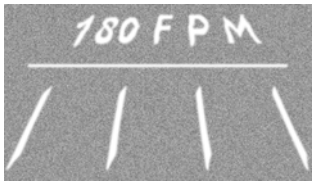


Figure 18: Travel Speed to Reduce Tow Point Force (“P”)

Truck Exchange, Another Tow Point Force

It is very important that truck exchanges be carried out as smoothly as possible to avoid disturbing the smooth, uninterrupted forward motion of the paver. The following lists some steps to take to avoid disturbance of the paving operation by trucks.

1. Stop the mix delivery truck close, but not too short of the paver. Always allow the paver to pickup trucks on the run.
2. Never allow the truck to bump the paver. Allowing trucks to bump the paver when backing up, can drive the screed into the mat and produces bumps and ridges which may not roll out.
3. Trucks applying and holding their brakes excessively while dumping their load may cause the paver to slow, which in turn causes the screed to rise. The truck driver should apply only light pressure on the brakes, sufficient to maintain contact with the paver.
4. Dumping of material in front of the paver as the truck pulls away after emptying its load into the hopper, can cause the paver to ride over the pile of material with subsequent adverse effects on mat quality. Avoid trucks pulling away prior to completely dumping all material. Use a dump person to monitor and regulate truck movements in front of the paver.

Head of Material (M)

One of the primary functions of the paver tractor is to convey and distribute paving material onto the ground in front of the entire width of the screed. This material, once deposited in front of the screed is the head of material over which the screed passes.

One of the keys to smooth paving is to maintain this head of material as constant as is possible. The resistance to forward motion exerted by the head of material (**M**) is one of the major component of resistance to forward motion (Figure 19). Control of this force is a basic and necessary function of any paving operation.

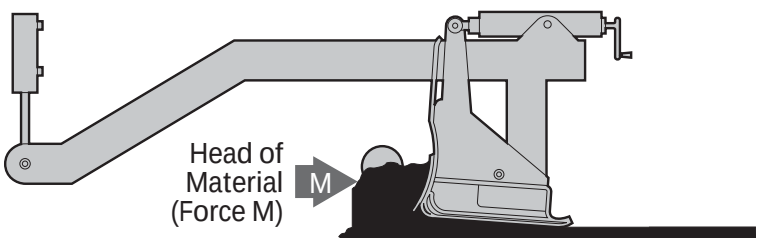


Figure 19: Head of Material Force (M)

The volume and consistency of the head of material determines how much paving material flows under the screed and influences mat thickness and surface texture.

The most common factor affecting force (**M**), the head of material, is incorrectly adjusting the Automatic Feeder Controls.

These systems, whether of the “hanging paddle” type or the sonic sensor type, should be adjusted to operate the auger/conveyor assemblies 95% to 100% of the time. On/off operation of the auger system causes fluctuation in the head of material.

The highest quality mat generally results when a constant head of material is maintained across the entire width of the screed and the material almost covers the auger shaft. If the volume of paving material is too high, there is resistance to the travel of the screed. This causes the screed to rise and can result in ripples, auger shadows and long waves. It also results in increased auger wear (Figure 20).

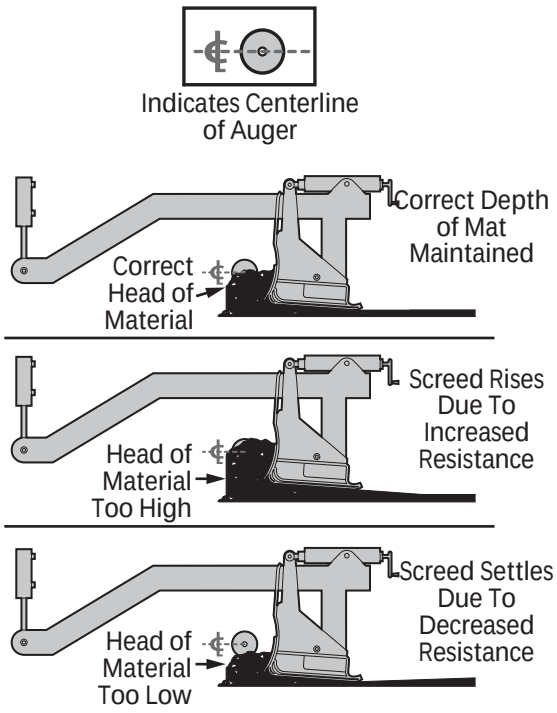

Indicates Centerline of Auger
Correct Depth of Mat Maintained
Correct Head of Material
Screed Rises Due To Increased Resistance
Head of Material Too High
Screed Settles Due To Decreased Resistance
Head of Material Too Low

Figure 20: Head of Material Affects Mat

Reaction of Material Under Screed (R)

Ideally, every truck load of material delivered to the paver would be exactly like every other load, with no variation. However, as a practical matter, changes in mix characteristics such as mix temperature, density, gradation, A.C. Content, segregation, etc., affects the internal stresses developed within the mix, which in turn affects the resistance of the mix to flow under the screed, also known as the reaction of material under screed

(**R**). The key element to bear in mind is that the screed passing over the paving material compacts the material to a certain degree. Variables in the resistance of the material to compactive forces causes changes in the screed's angle of attack, which in turn affects mat thickness and therefore mat smoothness (Figure 21).

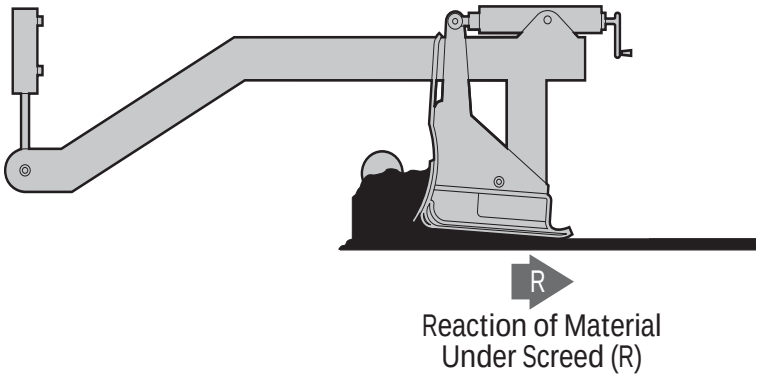


Figure 21: Reaction of Material Under Screed

Gradation Mix Characteristics

This aspect of the paving material varies according to the intended use of the material as abase course, binder course or the final wearing surface. Normally, maximum aggregate size, ratio of aggregates, fines content and most importantly, asphaltic binder content, is specified by the contracting agency.

Adherence to mix design specifications is usually the responsibility of the material supplier.

Segregation is a material deficiency caused by a separation of the larger aggregate sizes from the bulk of the paving material.

This condition is encountered especially in mixes with relatively large maximum size aggregate (example: 1" and larger, the so called “large-particle” mixes). When paving material is deposited in piles, as in an asphalt plant silo, a haul truck, a paver hopper, on the ground in front of the paver in a windrow, or on the ground in the auger chamber, segregation can and does frequently occur.

The areas listed above where segregation can occur are all areas that the material may encounter before being laid down as a mat. Therefore, these areas of segregation must be addressed prior to any paving. The screed cannot rectify segregation during the paving process.

Segregation can also be the result of improper hopper dumping.

During normal operation, the vibration of the pavers hopper causes segregation. Therefore, dumping the hopper after each truck should be avoided because material that has rolled to the outside of the hopper (the large aggregate) fills the conveyors and auger chamber and result in a segregated area behind the paver with a noticeable difference in surface texture.

If it doesn't look right, it isn't right: Surface and texture irregularities indicate that the homogeneous characteristics of the material in the mat have been interrupted, which usually results in bumpiness and premature failure of the pavement in those areas.

Segregation can also be the result of excessively worn augers: “Center Streak” segregation can be caused by worn “Kicker Paddles” at the center chain cause or near the outside auger bearings. In fact, center streak segregation is frequently caused by incorrect arrangement of the auger segments adjacent to the auger chain case. (Consult the Manufacturers Manual).

"Center Streak" segregation is also caused by feeder gates being set to tow. Adjust as necessary to provide sufficient uniform material at the center of the paver.

"Center Streak" segregation can be limited and even eliminated by slowing paving speed.

Mix Temperature Characteristics

A common paving problem is inconsistent temperatures in the asphalt mix. As the material cools it loses its viscosity making it more difficult to compact. If the resistance to compaction increases, the screed naturally increases its angle of attack and begin to float up. This changes the mat depth, resulting in bumps in the surface. If the mix and or screed temperature are too low, the screed may no longer slide smoothly over the material and a tearing of the mat occurs.

Simple steps to take to control temperature variations:

1. Ensure that haul trucks take the shortest, most practical route to the paver. Make certain that all trucks take the same route to the paver.
2. Make sure that the trucks arrive at the same order in which they were loaded at the asphalt plant.
3. Ensure that no bunching of trucks occurs at the paver, with several trucks waiting to dump their loads.
4. Match lay-down rate to material delivery rate.

Temperature problems may occur before the time the material is loaded into the trucks, or during the trip to the paver. They can be the result of temperature variations at the plant. If this is not addressed prior to delivery of material to the paver, waviness in the mat results.

Weight of Screed (W)

For the weight of screed force (**W**) to remain constant, the weight of the screed, or the downward pressure exerted by the screed on the paving material, should not change (Figure 22). The weight of the screed is measured in pounds per square inch.

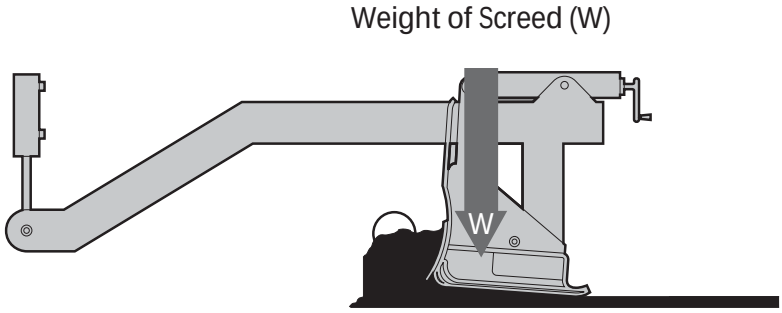


Figure 22: Weight of Screed

Members of the paving crew climbing on and off the screed also have some affect on the weight of screed force.

The primary factor affecting this force is changing the width of the screed (Figure 23). Extendible screeds weigh the same whether they are fully retracted or fully extended. The difference is the wider the extension of the screed the greater the surface area of paving material to support. An extended screed has fewer psi, which means less compaction, causing the screed to raise.

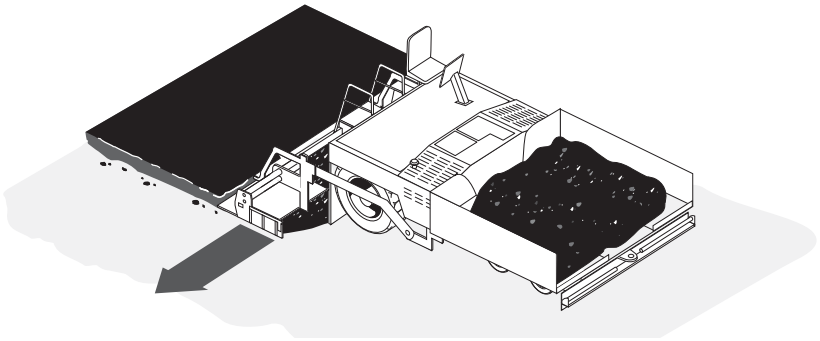


Figure 23: Width of Screed Affects Weight of Screed

Quality of Paving Base

There are factors other than the four main forces that can have an effect on the quality of the mat. An important one is the quality of the base to be paved. It makes more sense to build smoothness from the base up, than to try to smooth a road in the last lift of paving. However, on overlay paving jobs, we have to work with what we have.

Remember that a mat which appears smooth immediately behind the paver, may actually contain areas of considerably varying thickness of material as a result of undulations in the base being paved. Due to the principle of “Differential Compaction” high spots do not compact as much as the low, therefore allowing some of the irregularities to be rolled back onto the mat (Figure 24). To minimize this problem, lay a leveling course in the low spots or pave multiple lifts to average out the irregularities.

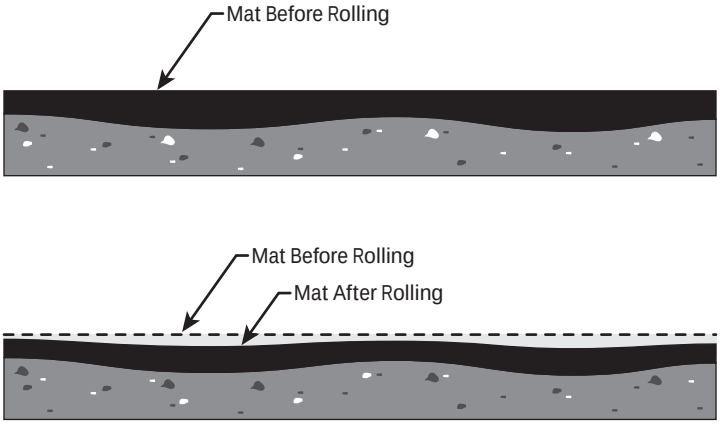


Figure 24: Differential Compaction

Rolling Techniques

A well laid mat can end up with a poor ride quality if proper rolling methods are not followed. Consult your compaction equipment manufacturer's manuals and handbooks on compaction techniques.

Controlling Mat Quality

The primary purpose of the asphalt paver is to place a smooth mat of material. The primary function of your Topcon P-32+ or P-32 System is to control the vertical position of the screed in relation to the surface being paved. Automatic grade and slope control systems can help tremendously in controlling mat smoothness but mat quality is also dependent on the following factors:

- Non-stop, continuous operation of paver
- Constant speed of paver
- Truck exchange
- Head of material
- Mix characteristics
  – Gradation
  – Segregation
  – Mix Temperature
- Screed Compaction
- Quality of Base Being Paved
- Rolling Techniques

Changes in any of these factors cause a change in mat thickness, density, surface appearance and mat quality. If changes must be made, make them as gradually as possible. Abrupt changes in any of the above factors produce rapid changes in mat thickness, adversely affecting mat quality.

Control Methods

The following sections describe the three types of control possible with your Topcon P-32+ or P-32 System: sonic, laser, and slope.

Sonic Control

You can choose either Topcon's ST-3 (P-32+ System) or the Sonic Tracker II (P-32 System) as a sonic control elevation reference for your system.

The Trackers measure and control the elevation of the screed, controlling grade from a physical grade reference, such as a curb, stringline, or existing road surface. For both the ST-3 and Sonic Tracker II, a transducer, located in the Tracker, generates a number of sound pulses per second and listens for returned echoes like a microphone. As soon as the Tracker sends out a sound wave, it starts a stop watch.

The sound waves go down, bounce off of a physical reference, and reflects back to the Tracker. The Tracker measures the time it takes for the sound wave to return to the Tracker. Knowing the speed of sound, the Tracker accurately calculates the exact distance to the grade reference (Figure 25).

The ST-3 is Topcon's new generation Sonic Tracker. The ST-3 was designed after years of experience with non-contacting sonic grade controls in the construction industry.

The ST-3 has two detection modes to ensure the best accuracy possible as well as changing sensor characteristics to optimize the detection zone based on the application. The two modes are Surface Mode and Stringline Mode. Surface Mode is used to detect the ground or curb. While in Surface Mode, the grade indicators display the traditional up/down and ongrade arrows. Stringline Mode is used to detect an elevated stringline.

While in Stringline Mode, the grade indicators display left/right and centered arrows. You can select the mode through the GC-35 Slope Sensor, using firmware version 1.1 or newer, under the Sonic Tracker 3 menu item. The GC-35 screen displays an icon as a reminder of which mode is active.

Sonic Tracker II shown.

Both the ST-3 and Sonic Tracker II use similar technology.

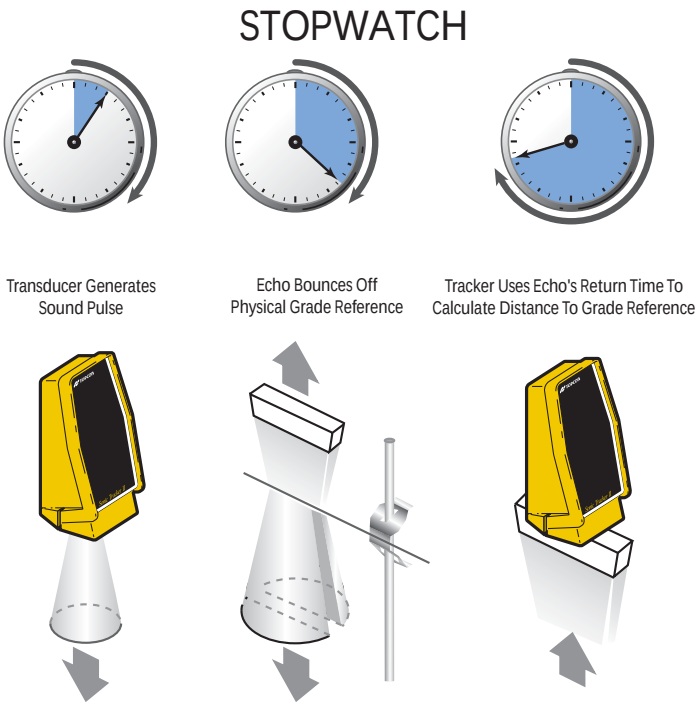

STOPWATCH
Transducer Generates Sound Pulse
Echo Bounces Off Physical Grade Reference
Tracker Uses Echo's Return Time To Calculate Distance To Grade Reference

Figure 25: Timed Sound Pulses Determine Distance (ST-3 and Sonic Tracker II)

Laser Control

For Laser Control a laser transmitter is used to produce a plane of light which becomes the grade control reference for the job site. The Laser Receiver controls the screed to lay a mat parallel to the laser beam reference.

When the laser beam is in the center of the receiver, it indicates an On-Grade signal (Figure 26).

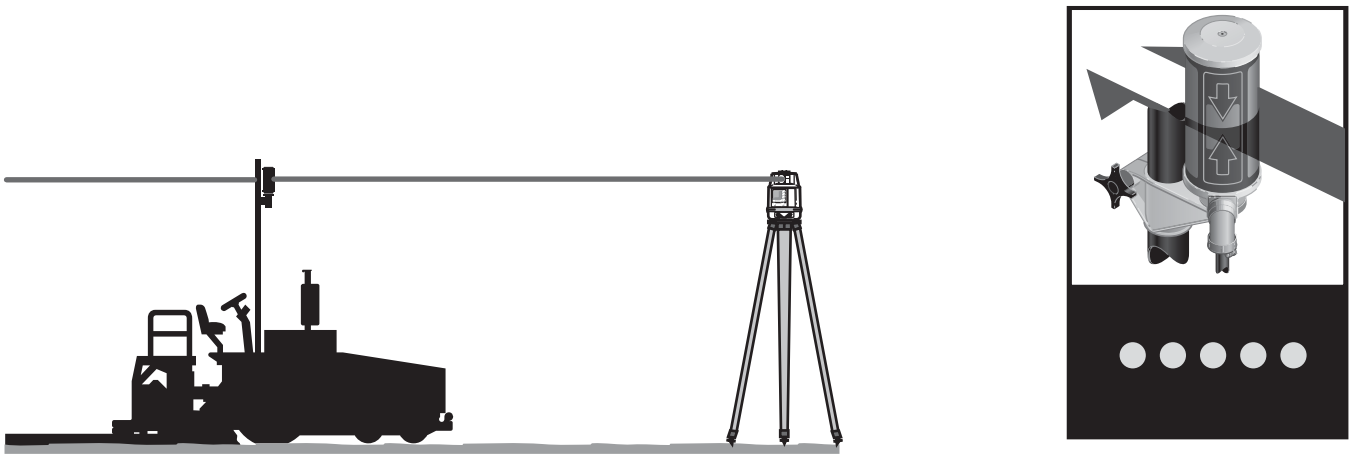


Figure 26: Laser Control – On-Grade

As the screed is raised, the beam of light hits the Laser Receiver below the center and a lower signal is indicated (Figure 27 on page 16).

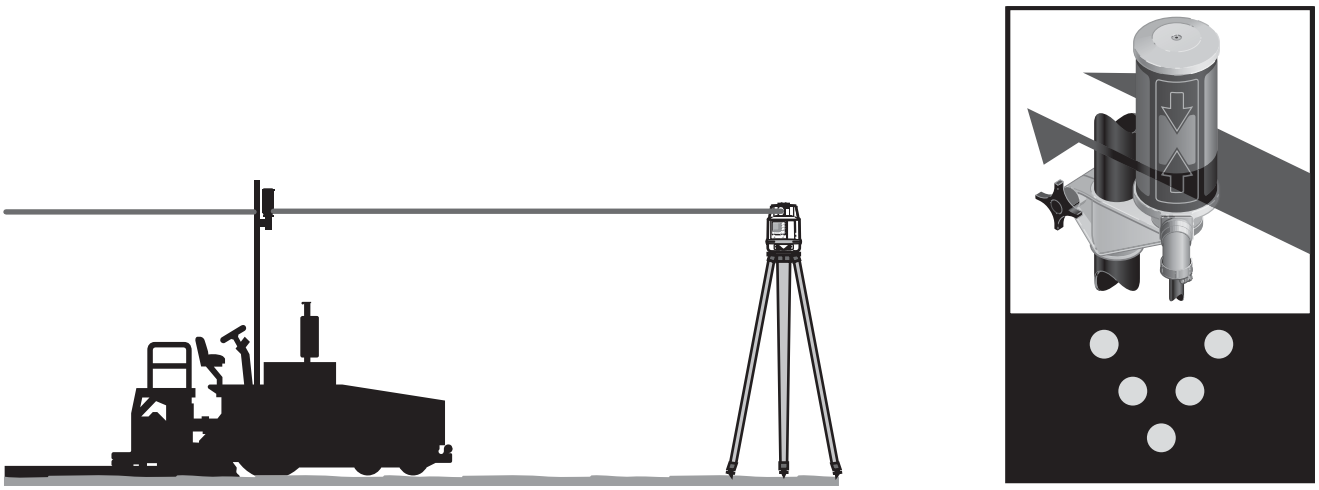


Figure 27: Laser Control – Above Grade

As screed is lowered the beam of light hits the Laser Receiver above the center a raise signal is indicated (Figure 28).

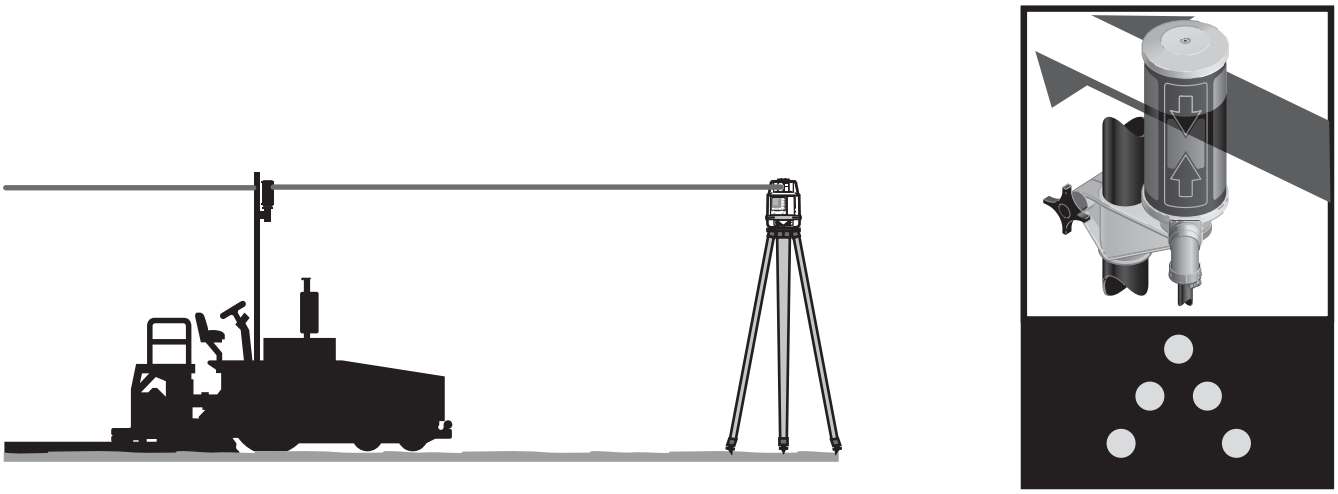


Figure 28: Laser Control – Below Grade

Setup

For the first pass, use slope control on one side of the screed and a Laser Receiver on the other side (Figure 29 on page 17).

Make sure that the slope percentage of the laser and Slope Sensor are equal or the joints will not match.

For all subsequent passes, replace slope control with elevation control by using a Sonic Tracker. Continue to use a Laser Receiver on the other side of the screed.

Using a Slope Sensor allows you to evenly match the joints between passes over large areas.

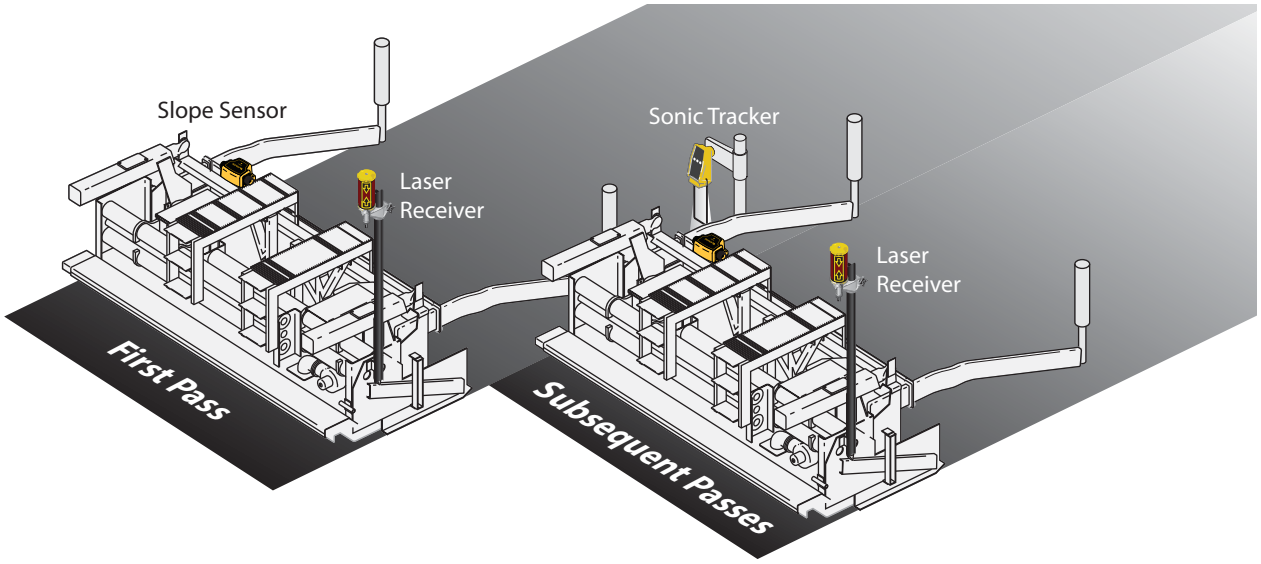


Figure 29: Laser Control Setup

Slope Control

Your Topcon P-32+ or P-32 System uses a Slope Sensor mounted to the transducer beam on the paver to measure and control the slope of the mat being laid (Figure 30). The sensor contains an electronic level vial, that acts as a “precision carpenter's level”. Slope control with this electric level vial is very accurate and repeatable.

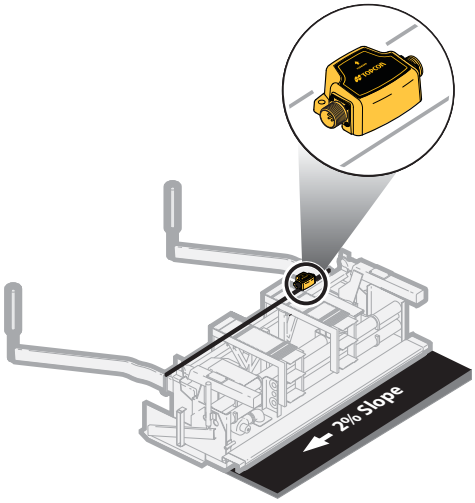


Figure 30: Position of Slope Control on Paving System

If the required slope changes, the screed operator dials the new slope into the Control Box (Figure 31). The tow point cylinder on the slope side raises or lowers until the Slope Sensor measures the new slope.

Cranking affects the relation between the Slope Sensor and the screed slope.

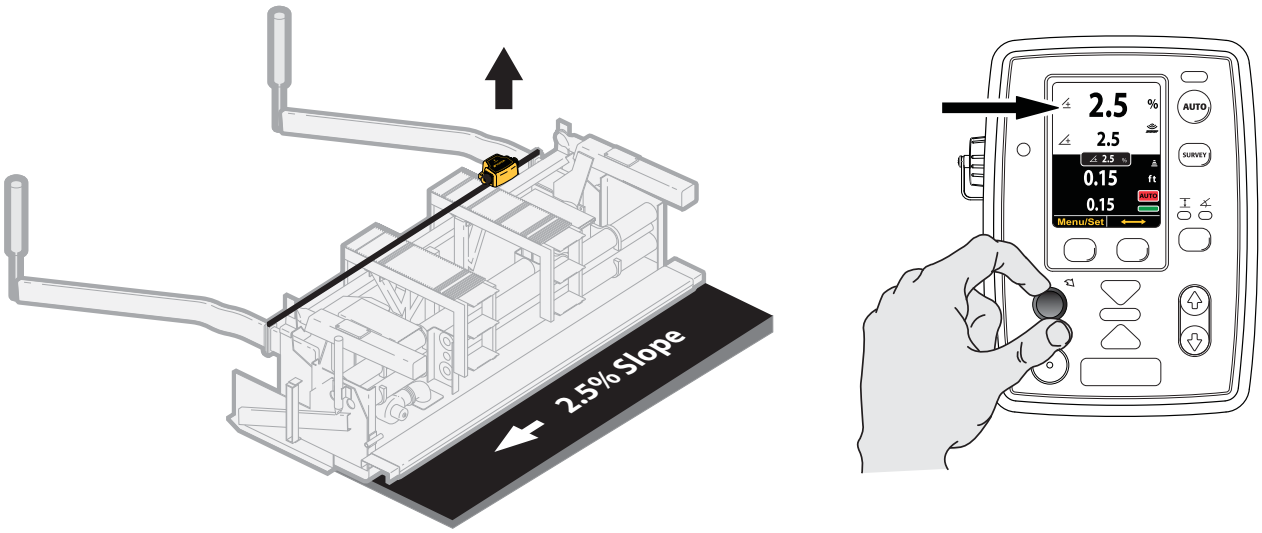


Figure 31: Using the GC-35 Control Box to Adjust the Slope

See “GC-35 Control Box Features and Setup” on page 32. for information on using the GC-35 Control Box.

This chapter describes the features and setup of your GC-35 Control Box including:

- The buttons, grade adjustment knob, and color LCD screen on the GC-35 Control Box.
- How to change settings, access information, and take readings using the Control Box.
- A description of the Control Screen.
- The menus available in the Performance Menu.
- How to access, change settings, and apply features using the Performance Menu.

Control Box Features

The Control Box is your user interface to the Topcon P-32+ or P-32 System. The Control Box receives signals from elevation sensors and an optional Slope Sensor, and uses these signals to determine if grade or slope corrections are necessary. If the paving requires a change in grade or slope, the Control Box sends a signal to the valve controlling the tow point cylinder on the appropriate side of the paver to raise or lower, thus maintaining correct mat thickness. You can control and monitor the slope and thickness of the mat using the buttons and display located on the front panel of the Control Box.

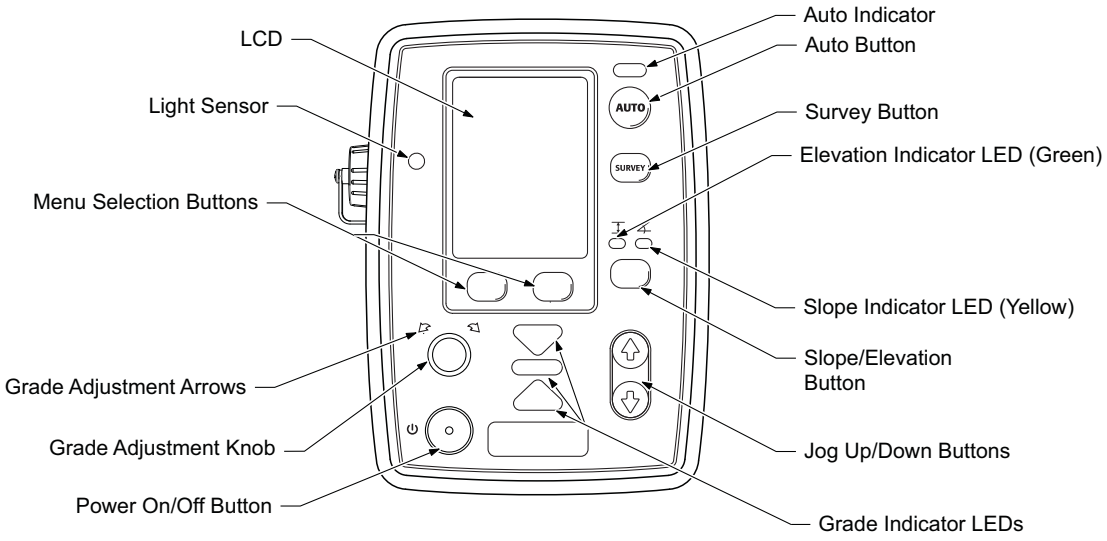


Figure 32: GC-35 Control Box

Color LCD Display

The color LCD display (Figure 33) allows the operator to view the Topcon P-32+ or P-32 System's elevation and/or slope settings, menus, and information about the Control Box. See "Control Screen" on page 29 and "Performance Menu" on page 29 for information on your Topcon P-32+ or P-32 System's user interface.

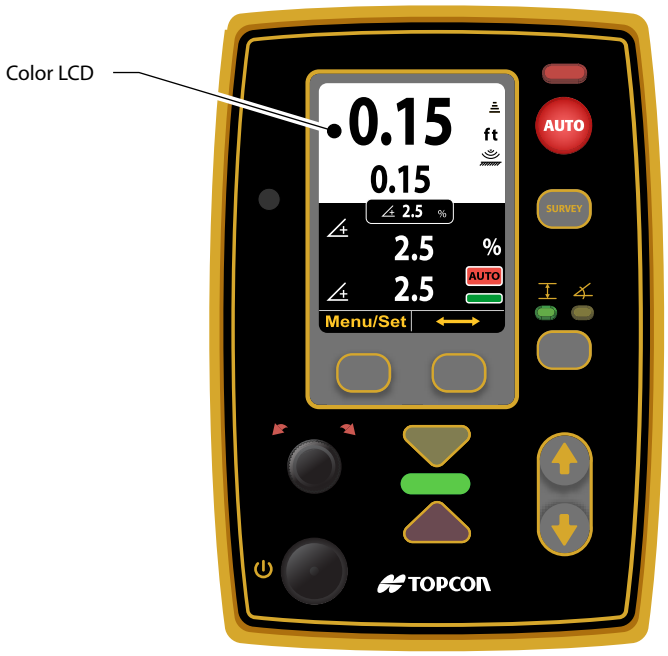


Figure 33: Color LCD Display

Light Sensor

The light sensor (Figure 34) monitors ambient light to adjust the brightness of the color LCD display for better visibility.

The light sensor is located to the left of the LCD display.

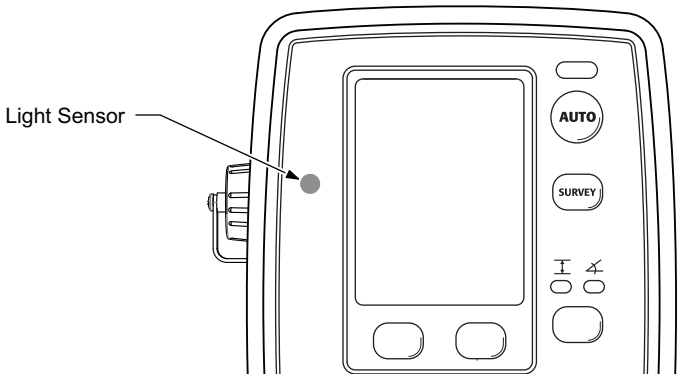


Figure 34: Light Sensor

Power Button

The power button (Figure 35) for the Control Box turns it on and off.

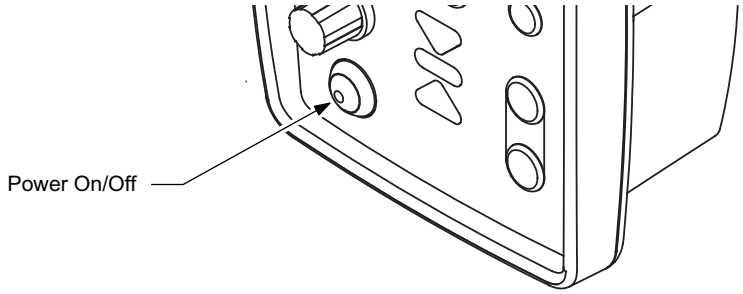


Figure 35: Power Button

Powering the Control Box On/Off

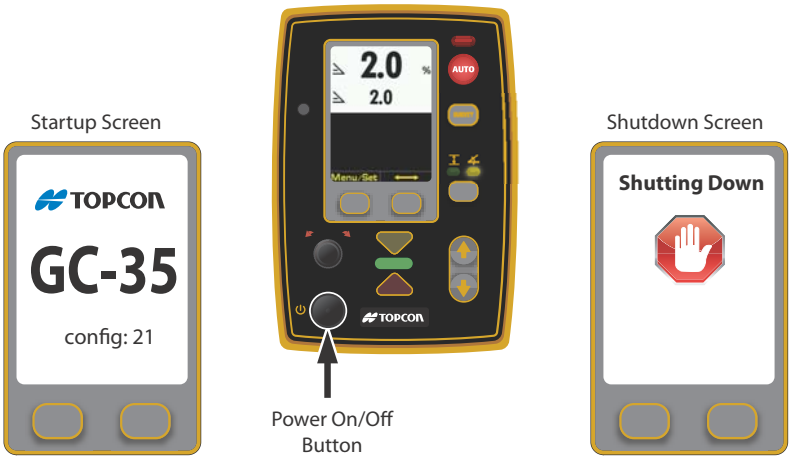


Figure 36: Power On/Off

Grade Adjustment Knob

The Grade Adjustment Knob (Figure 37) makes measured adjustments to elevation and slope settings, or cycles through menu options.

– Turn the **Grade Adjustment Knob** to adjust the grade height while in elevation control (Figure 37).

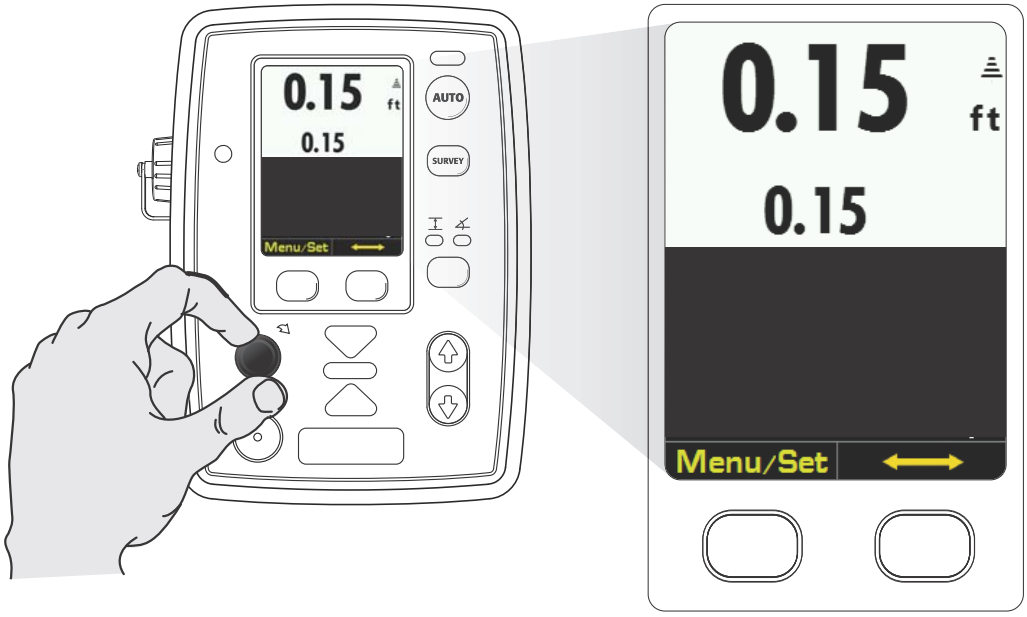


Figure 37: Grade Adjustment Knob - Adjust Elevation

– Turn the **Grade Adjustment Knob** to adjust the percentage of slope while in slope control (Figure 38).

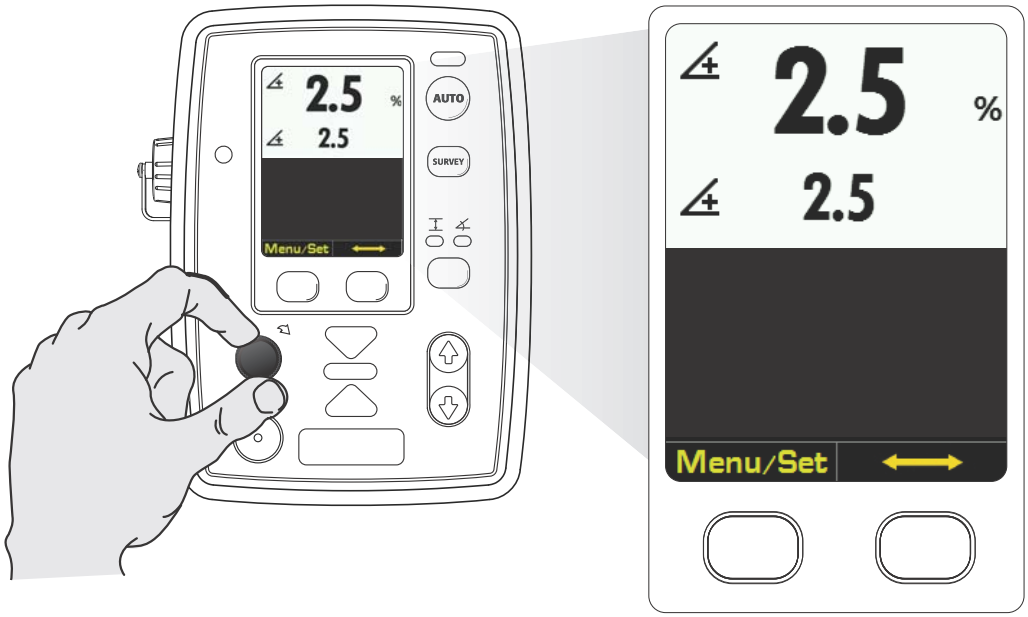


Figure 38: Grade Adjustment Knob - Adjust Slope

Grade Adjustment Direction Arrows

The Grade Adjustment Direction Arrows are located at the upper left and upper right of the Grade Adjustment Knob.

When your Topcon P-32+ or P-32 System is set to Manual control, the **Grade Adjustment Direction Arrows** (Figure 39) light up in red to indicate the direction to turn the knob to reach On-Grade.

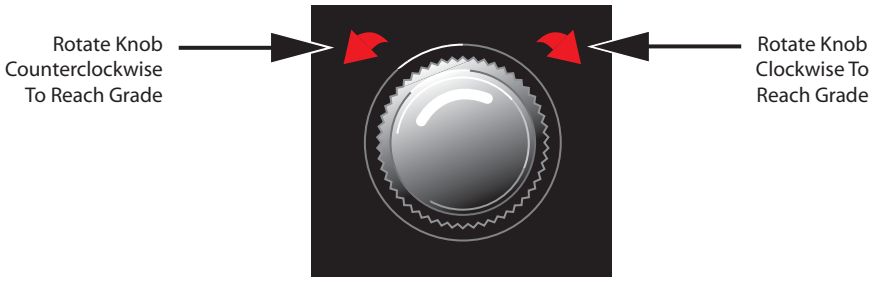


Figure 39: Grade Adjustment Direction Arrows

Grade Adjustment LEDs

The Grade Adjustment LEDs (Figure 40) indicate raise, On-Grade, and lower information and corrections. See Table 1 for a description of the Grade Adjustment LED indications.

Figure 40: Grade Adjustment LEDs

Table 1 describes grade adjustment LED indications. The values listed in Table 1 are default factory values.

Table 1. LED Indications for Elevation/Slope Control

LED Display	LED	Elevation Description	Slope Description
Slowly blinking, yellow down arrow		Outside of Working Window; beyond 0.2 ft above grade (no valve control)	Outside of Working Window; beyond 2% above grade
Solid yellow down arrow		Above grade; between 0.05 ft and .2 ft	Above grade, between 1% and 2%
Blinking yellow down arrow		Above grade; between 0.02 ft and .05 ft	Above grade, between 0.5% and 1%
Blinking yellow down arrow w/ green bar		Within 0.02 ft of grade	Within 0.5% of grade
Blinking green bar		On grade	On grade
Blinking red up arrow w/ green bar		Within 0.02 ft of grade	Within 0.5% of grade
Blinking red up arrow		Below grade; between 0.02 ft and 0.05 ft	Below grade, between 0.5% and 1%
Solid red up arrow		Below grade; between 0.05 ft and 0.2 ft	Below grade, between 1% and 2%
Slowly blinking red up arrow		Outside of Working Window; beyond 0.2 ft below grade (no valve control)	Outside of Working Window; beyond 2% below grade

Menu/Set Button

The Menu/Set Button (Figure 41) has two functions:

- Menu – used to access the Performance Menu.
- Set – used to change the reference number viewed on the display.

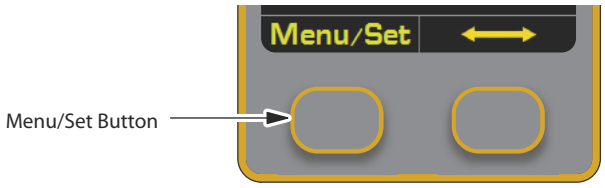


Figure 41: Menu/Set Button

Menu

Press the **Menu/Set Button** to enter the **Performance Menu**. The **Performance Menu** allows you to set valve offsets, units of measurements, elevation and slope deadband, and other useful functions.

See “Performance Menu” on page 29 for information on using the menu settings.

Set

Set is used to change the reference number viewed on the display for elevation or slope.

By using Set you are only changing the reference number viewed on the display, leaving the existing cutting depth unchanged.

1. From the **Control Screen**, press and hold the **Menu/Set Button**.
2. Turn the **Grade Adjustment Knob** to change the reference number. The reference number turns red to indicate the Control Box is in Set Mode.
3. Release **Menu/Set** to save the value.

Cross Communication Button

If enabled, the Cross Communication button (Figure 42) allows you to remotely control a secondary Control Box.

Cross communication is only available when the Cross Communication Indication Arrows icon is visible (Figure 44). If a secondary Control Box is connected and the icon is not visible see “Troubleshooting” on page 94.

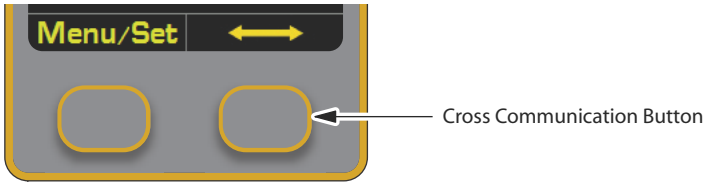


Figure 42: Cross Communication Button

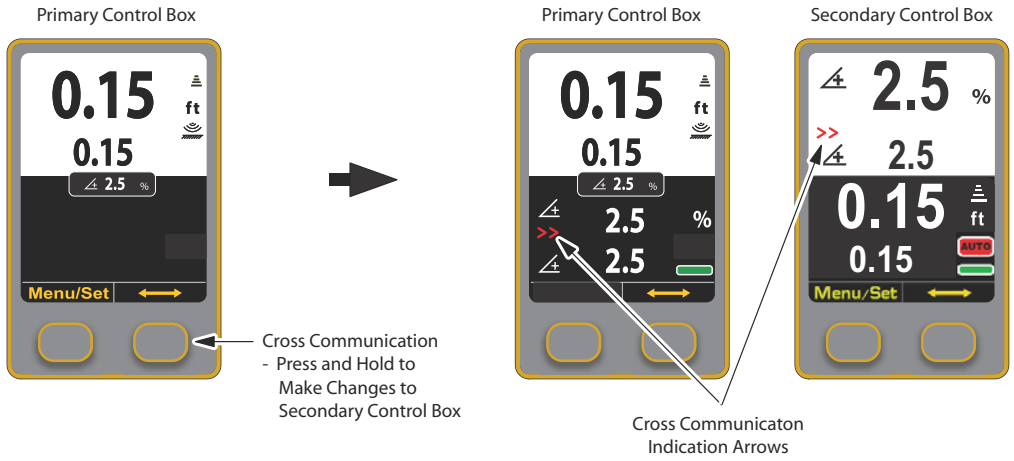


Figure 43: Cross Communication Indication Arrows

During Cross Communication, the Control Box that initiates the communication (primary) displays and controls the settings of the secondary Control Box in the bottom half of the screen.

While in Cross Communication mode you can make the following changes to the secondary Control Box:

- Switch the secondary Control Box into Automatic or Manual mode.
- Adjust the slope or elevation values using the Grade Adjustment Knob.
- Survey to On-Grade.
- Select slope or elevation sensor.
- Jog up/down.

1. Press and hold the **Cross Communication Button** (Figure 44).
   Red double arrows display on the screen once cross communication with the secondary Control Box is established. The bottom half of the display shows the settings of the secondary box.

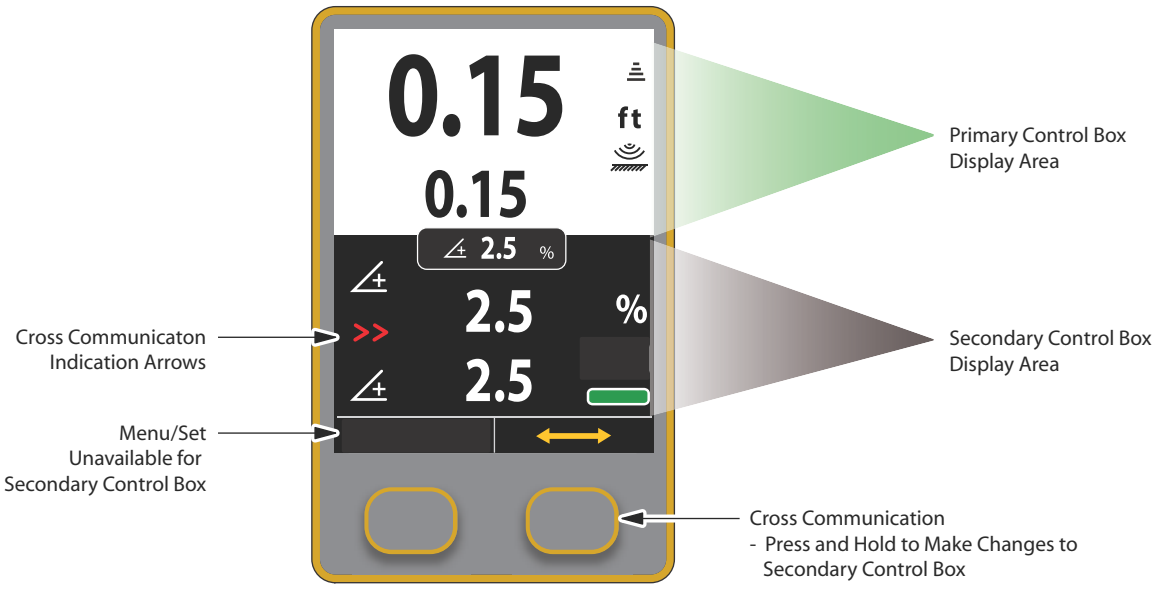


Figure 44: Cross Communication Established – Secondary Control Box Control Enabled

2. While holding **Cross Communication**, view or make changes to the settings in the secondary box.

The Menu/Set Button and access to the secondary Control Box's Performance Menu is disabled while in Cross Communication.

3. When finished, or to apply new settings to the secondary box, release **Cross Communication**.

Elevation/Slope Button

Use the Elevation/Slope Button (Figure 45) to switch your Topcon P-32+ or P-32 System between slope and elevation control.

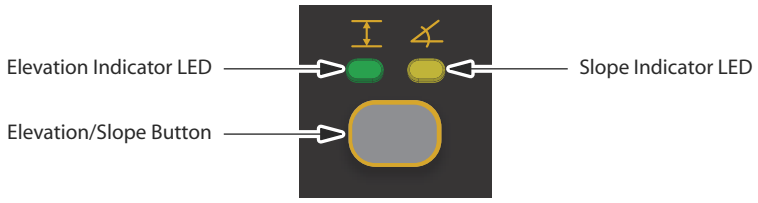


Figure 45: Elevation/Slope Button

Elevation Control

1. Press the **Elevation/Slope Button**. The green elevation indicator LED below the elevation symbol illuminates.
2. Turn the **Grade Adjustment Knob** to set the desired elevation.

Slope Control

1. If the Control Box is connected to a Slope Sensor, press the **Elevation/Slope Button**: the yellow slope indicator LED below the slope symbol illuminates.
2. Turn the **Grade Adjustment Knob** to set the desired slope.

Survey Button

Press the **Survey Button** (Figure 46) to lock On-Grade.

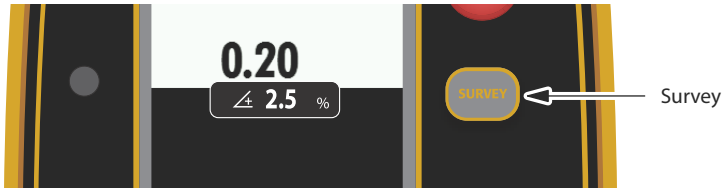


Figure 46: Survey Button

Auto Button

The AUTO Button (Figure 47) switches your Topcon P-32+ or P-32 System between Automatic and Manual Mode..

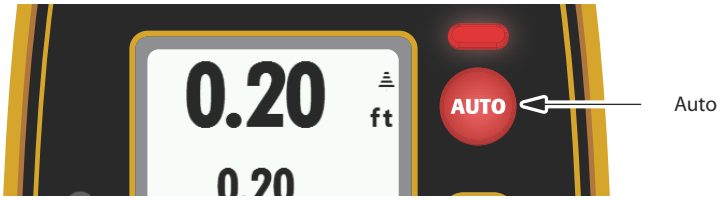


Figure 47: Auto Button

Automatic Mode

In Automatic Mode (Auto), the tow point cylinders are automatically adjusted up or down to maintain proper grade.

To enter Auto, press **AUTO**. The red LED lights up showing that the Control Box is in Auto.

Manual Mode

In Manual Mode (Manual), the LCD displays grade corrections without adjusting the tow point cylinders. In this mode, the operator manually adjusts the tow point cylinders to reach On-Grade.

To enter Manual, press **AUTO**. The red LED goes dark (unlit), showing that the Control Box is in Manual.

Jog Up/Down Button

The Jog Up/Down Button (Figure 48) manually moves the tow cylinder up or down, and is always active when the Control Box is turned on.

– To raise the tow cylinder, press **Jog Up**.
– To lower the tow cylinder, press **Jog Down**.

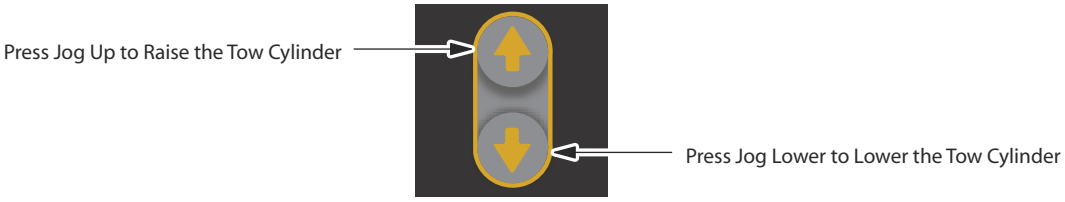


Figure 48: Jog Up/Down Button

USB Port

The USB Port (Figure 51) is used to update the Control Box's firmware. See "Updating Firmware" on page 39 for instructions on updating firmware..

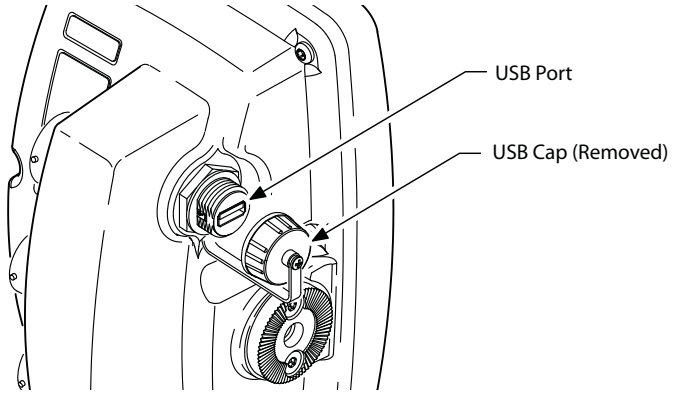


Figure 49: USB Port

Connectors

The Control Box connectors (Figure 51) connect to the Sonic Tracker(s), the Slope Sensor (optional), and power.

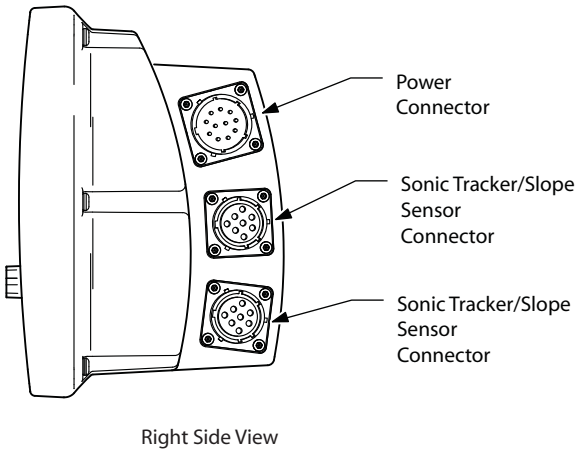


Figure 50: Connectors

Jaw Mount

A Control Box bracket attaches to the Jaw Mount (Figure 51) and allows easy removal of the Control Box from the machine.

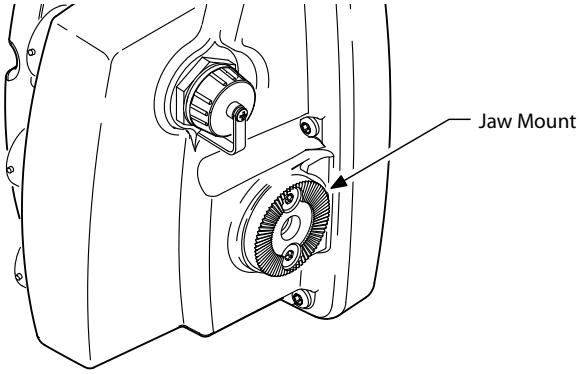


Figure 51: Jaw Mount

Control Screen

Figure 52 is an example of the GC-35 Box's Control Screen. The Control Screen is your interface with the components of your Topcon P-32+ or P-32 System. The Control Screen changes depending on how you have configured your Control Box and your Topcon P-32+ or P-32 System. The screen also changes if you are using a Secondary Control Box and are using Cross Communication. See "Display" on page 36 and "Cross Communication Button" on page 24 for more details.

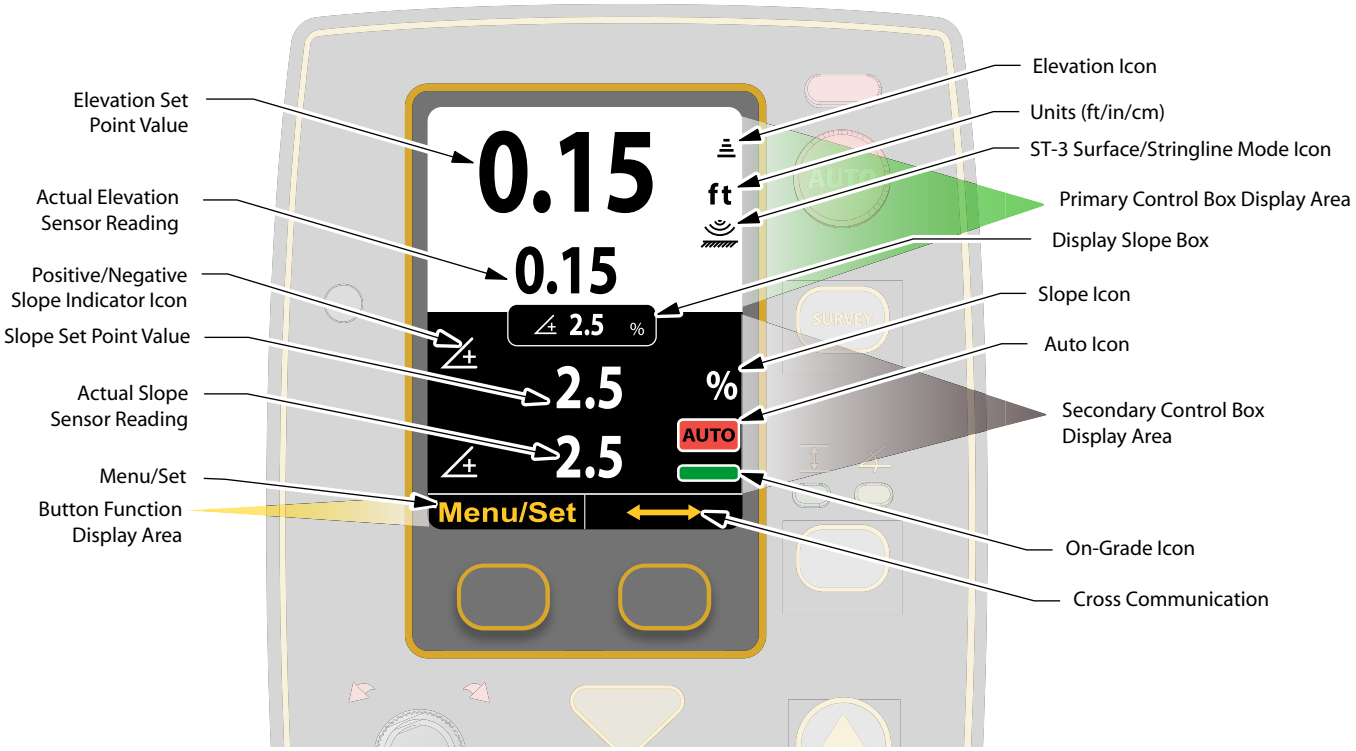


Figure 52: Control Screen - Example

Performance Menu

The items listed in the Performance Menu allow you to modify your Topcon P-32+ or P-32 System settings for operator or performance enhancement. The Control Box automatically stores all operating information

For some machine configurations, some menu selections are inaccessible.

Table 2 lists the Performance Menu items and their settings.

Table 2. Performance Menu Settings

Number	Menu Item	Range	Factory Default
1	Elevation Gains	1 – 200	25
2	Slope Gain	1 – 200	25
3	Valve Offsets	1 – 999	135
4	Elevation Deadband	1 – 30 mm	3 mm
5	Slope Deadband	0.025% – 0.75%	0.075%
6	Averaging	1 – 100	50

Table 2. Performance Menu Settings (Continued)

Number	Menu Item	Range	Factory Default
7	Machine Type	Paver	Paver
8	Display	Set point, + Sensor, Both sides Show slope (checked or unchecked)	+Sensor, Show slope (unchecked)
9	Units	centimeters, inches, feet	inches
10	System Info	N/A	Displays the Topcon logo, copyright date, and current firmware version. Interface to Update Control Box Firmware.
11	Sonic Tracker 3	Surface, Stringline Use at power up (checked or unchecked)	Surface Use at power up (unchecked)
12	Slope Resolution	0.1%, 0.05%	0.1%
13	Slope Cal. Block	Off, On	On
14	Tech Menu	N/A	N/A

Default settings are preset values that run most pavers. If your machine does not perform properly within those preset values, adjust the setting accordingly until you have satisfactory machine performance.

Selecting Performance Menu Items

Follow these steps to access the Performance Menu, select Performance Menu items, and make changes.

1. From the **Control Screen**, press the **Menu/Set** button (Figure 53).
2. Rotate the Grade Adjustment Knob to scroll through the menu selections displayed on the screen (Figure 53), and press the **Enter** button to select a menu item.

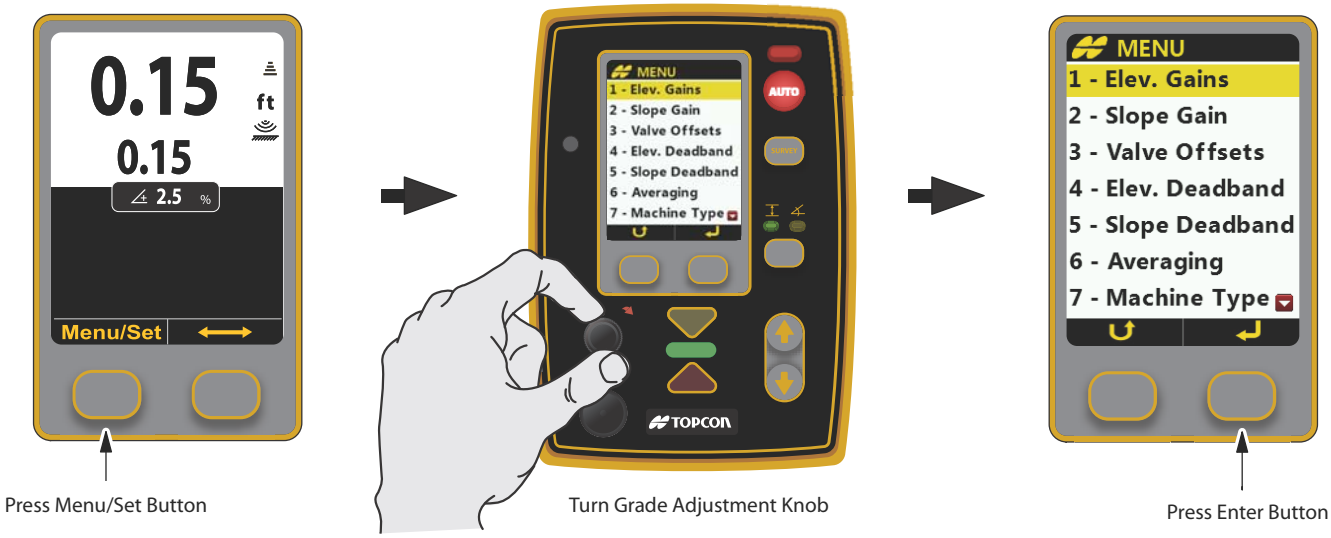


Figure 53: Accessing the Performance Menu

3. Press to highlight the value in blue (Figure 54), and then use the **Grade Adjustment Knob** to change the value.

Figure 54: Changing and Storing the Value

4. Press ✓ to store the value (Figure 54), or press ✗ to cancel and revert back to the original value.

If power is interrupted to the Control Box within two seconds after making an adjustment, the Control Box does not have time to store the new setting and reverts to previous (or original) settings.

5. To access other **Performance Menu** items, turn the Grade Adjustment Knob.
6. To exit the **Performance Menu** and return to the **Control Screen**, press ↺.

Performance Menu Item Descriptions

The following sections describe each menu item in detail.

Elevation Gains (Raise and Lower)

Elevation Gains (Figure 55) determines the speed at which your Topcon P-32+ or P-32 System allows the tow point cylinders to adjust to a change in elevation. For faster hydraulic response, increase the gain value. For slower hydraulic response, decrease the gain value.

The objective is to set the gain so the screed reacts to the change in grade quickly, but without “overshooting” the new elevation.

- Gain Elevation Value Range: 1-200
- Factory Preset: 25

Before setting the Elevation Gain, make sure the machine's hydraulic flow controls valves are adjusted for proper cylinder speed according to the manufacturer's recommendations.

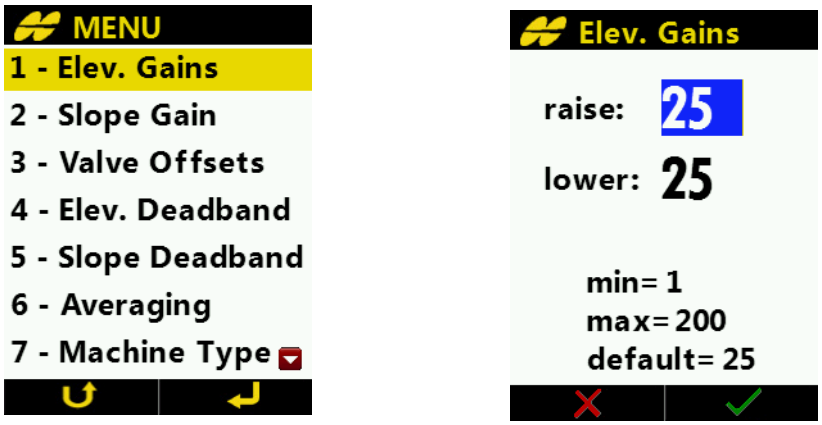


Figure 55: Gain Elevation

Slope Gain

This setting determines the speed at which your Topcon P-32+ or P-32 System allows the tow point cylinders to adjust to a change in slope. For faster hydraulic response, increase the gain value. For slower hydraulic response, decrease the gain value.

The objective is to set the gain so the screed reacts to the change in grade quickly but without “overshooting” On-Grade. Slope Gain should not be set at a higher value than the Elevation Gain on the other side of the paver.

- Gain Elevation Value Range: 1-100
- Factory Preset: 25

Before setting the Slope Gain, ensure the machine's hydraulic flow control valves are adjusted for proper cylinder speed according to the manufacturer's recommendations.

Do not set slope gain at a higher value than the elevation gain on the other side of the paver. A higher value may cause the slope to be over reactive.

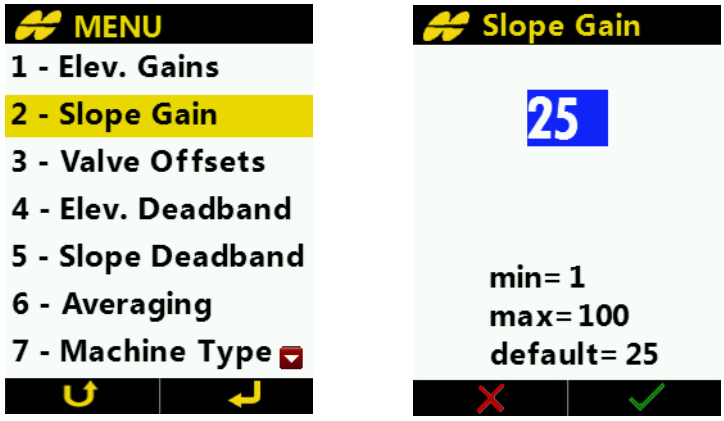


Figure 56: Slope Gain

Valve Offsets (Raise and Lower)

Valve Offsets is the minimum amount of electrical signals sent to the valve which causes the hydraulic cylinder to move. If the valve offset is too small, the sensor will not reach On-Grade. Likewise, if the valve offset value is too large, the sensor will move too much and overshoot On-Grade.

Set the Valve Offsets first, before setting any other Performance Menu items.

Valve offsets should be set before adjusting elevation and slope gains, and averaging. The paver should be run until the hydraulic oil is at normal operating temperature before setting the valve offsets. Once they are set, you should not need to readjust the valve offsets unless the Control Box is moved to a new paver, or the hydraulic performance changes.

- Valve Offset value range – 1 to 999
- Factory preset – 135

1. Select **Valve Offsets ▸ raise:**.
2. Turn the **Grade Adjustment Knob** counter clockwise, decreasing the **Valve Offset - raise** value until the hydraulic cylinder no longer moves. Then slowly rotate the **Grade Adjustment Knob** clockwise until the hydraulic cylinder just begins to move up.
3. Repeat for **Valve Offsets ▸ lower:**.

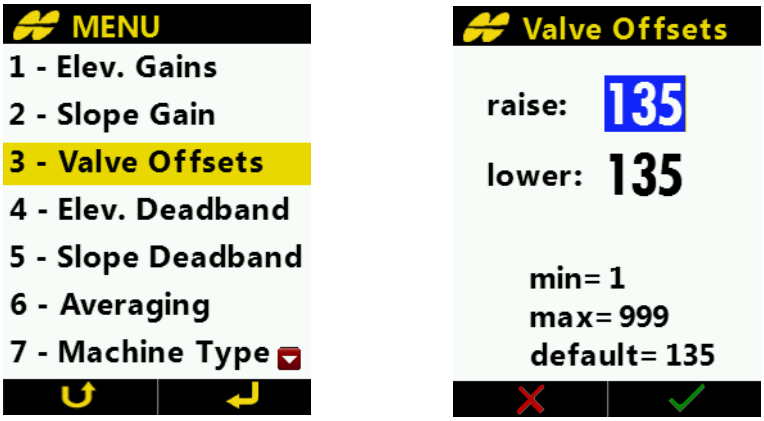


Figure 57: Valve Offsets

The offset value on one side of the paver may differ from the offset value on the other side of the paver. You must verify the offset values before swapping boxes. Use the “Left” and “Right” labels provided.

Never attempt to use Valve Offsets to compensate for a slower raise or lower speed of your hydraulic valves, as it causes undershooting or overshooting in Slope Mode and can adversely affect the quality of the mat.

Averaging

Averaging changes the amount of damping, or filtering, applied to Sonic Tracker and Laser Receiver measurements. You can think of it as a calculation of the running average of the elevation measurement over a period of time.

A lower value averages fewer elevation measurements, allowing the system to react more quickly to smaller grade changes. This makes the system more susceptible to fluctuations in temperature or small obstructions.

A larger value averages more elevation measurements, preventing the system from reacting to undesirable items close to the reference. This also makes the system less susceptible to fluctuations in temperature or small obstructions.

- Averaging value range – 1 to 100
- Factory preset – 50

Figure 58: Averaging

Elevation Deadband

Elevation Deadband is the area of the Working Window that is On-Grade. While the reference is within that area, the paver's valves are idle (closed). Therefore the wider the Elevation Deadband (On-Grade area), the more a reference can move up or down without a correction being initiated. Once the signal from the reference is out of the deadband, your Topcon P-32+ or P-32 System drives the hydraulics to place the reference back in the center of the deadband.

- Elevation Deadband value range – 1 mm to 30 mm
- Factory preset – 3 mm (0.01 ft or 1/8 in)

Select the amount of Elevation Deadband carefully. Too small of an Elevation Deadband causes the tow point cylinder to constantly hunt up and down while the sensor tries to find On-Grade. Too large of an Elevation Deadband does not allow the sensor to send grade corrections to the values, causing unwanted variations in mat thickness.

Figure 59: Elevation Deadband

Slope Deadband

Deadband is the area of the Working Window that is On-Grade. While the reference is within that area, the paver's valves are idle (closed). Therefore the wider the Slope Deadband (On-Grade area), the more a reference can move up or down without a correction being initiated.

When the Slope Deadband changes, it adds or takes away from the fine correction region (1% above or below On-Grade) of the Slope Sensor; it does not add this distance to the overall working range.

- Slope Deadband value range – 0.025 to 0.75%
- Factory preset – 0.075%

Select the amount of Slope Deadband carefully. Too small of a Slope Deadband causes the tow point cylinder to constantly hunt up and down while the sensor tries to find On-Grade. Too large of a Slope Deadband does not allow the sensor to send grade corrections to the values, causing unwanted variations in mat thickness.

Figure 60: Slope Deadband

Machine Type

Displays the type of machine configuration (not selectable).

Figure 61: Machine Type - Paver

Display

Display allows you to choose the amount of information available to the operator on the Control Screen. This section describes the three selections available; Set Point, +Sensor, and Both Sides (Figure 62). You can also check **Display slope** to allow the Slope Sensor to display the slope value even when it is in elevation mode ().

Also see “Control Screen” on page 29 for a description of the Control Screen.

- Display Value Range: Set Point, +Sensor, Both Sides, and Display Slope
- Factory Default: +Sensor

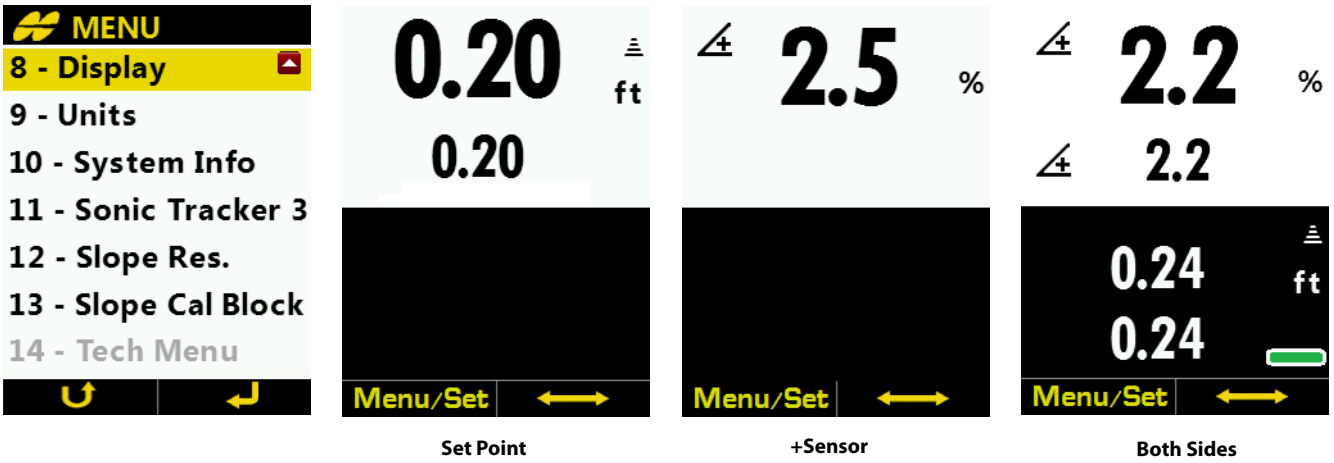


Figure 62: Display

Set Point

If you choose **Set point** as the display type, the Control Screen only displays the elevation or slope set point.

+Sensor

If you choose **+Sensor** as the display type, the Control Screen displays:

- the elevation or slope set point.
- the actual elevation or Slope Sensor reading.

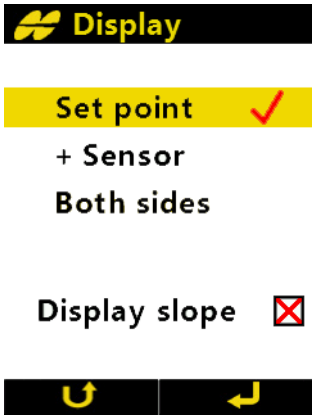
Both Sides

If you choose **Both sides** as the display type, the Control Screen displays:

- the elevation or slope set point.
- the actual elevation or slope set point.
- a live view of the secondary Control Box’s screen in the lower half of the screen.
  - – Elevation or slope set point
  - – Actual sensor readings
  - – Auto indication
  - – On-Grade arrow indication

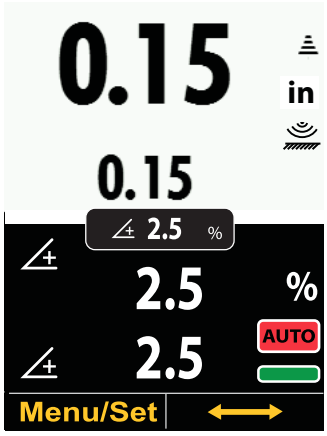
Display Slope

Check **Display slope** to show the slope value even when you are in Elevation Mode.



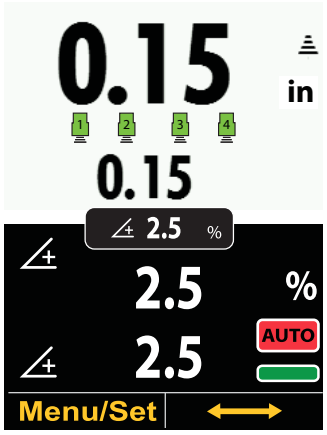
Set Point with Display Slope

+Sensor with Display Slope



Both Sides with Display Slope

Using ST-3 in Surface Mode



Both Sides with Display Slope

SAS

Figure 63: Display Slope

Units

Units sets the display to read in feet, inches, or centimeters.

- Display Value Range: Centimeters, Inches, or Feet
- Factory Default: Inches

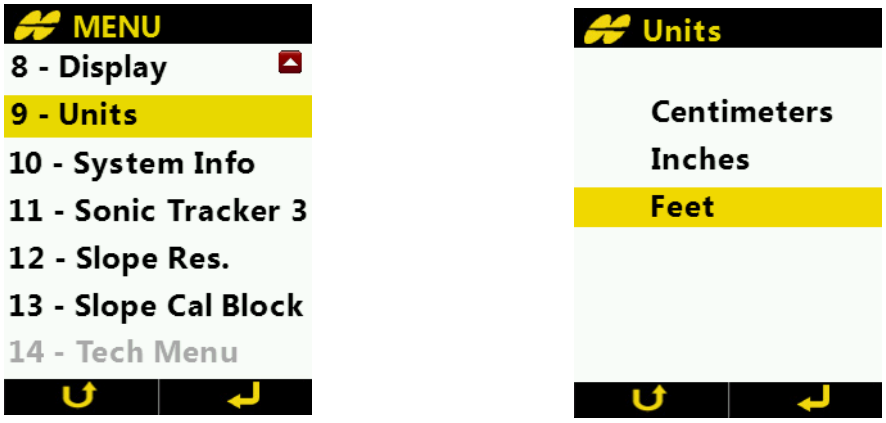


Figure 64: Units

System Info

System Info displays the Topcon logo, copyright date, and current firmware version.
The System Info menu item is also the interface that allows you to update Control Box firmware.

1. From the Performance Menu, press the **Enter** button ↵ to select **System Info** (Figure 65) and view the copyright date and firmware version.

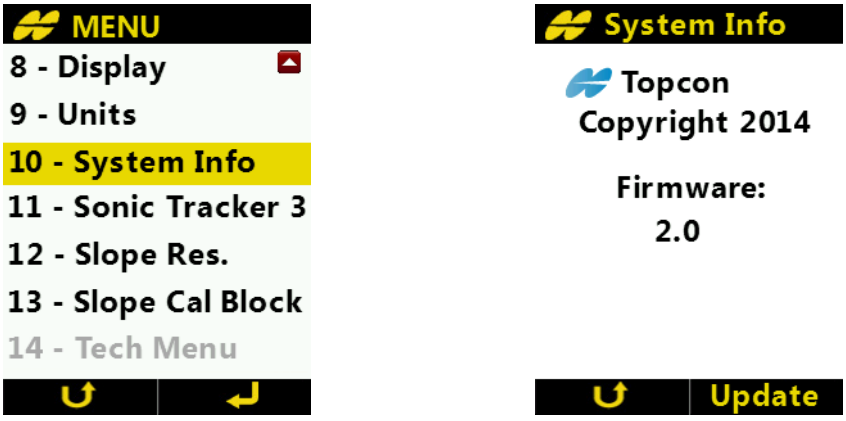


Figure 65: System Info

Updating Firmware

1. Unscrew the USB cap.
2. Insert a USB key into the Control Box's USB port (Figure 66)

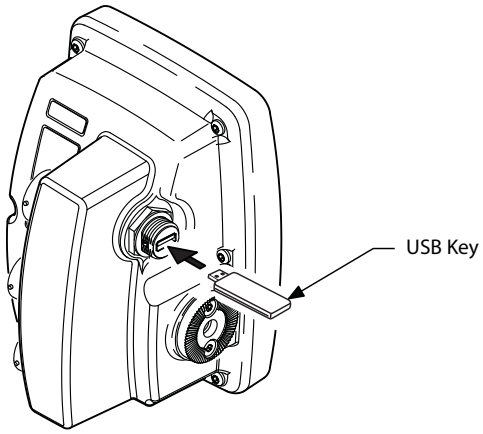


Figure 66: Insert USB Key

3. From the **Performance Menu**, press the **Enter** button to select **System Info** (Figure 67)
4. Press **Update**, and then press **Load** (Figure 67).

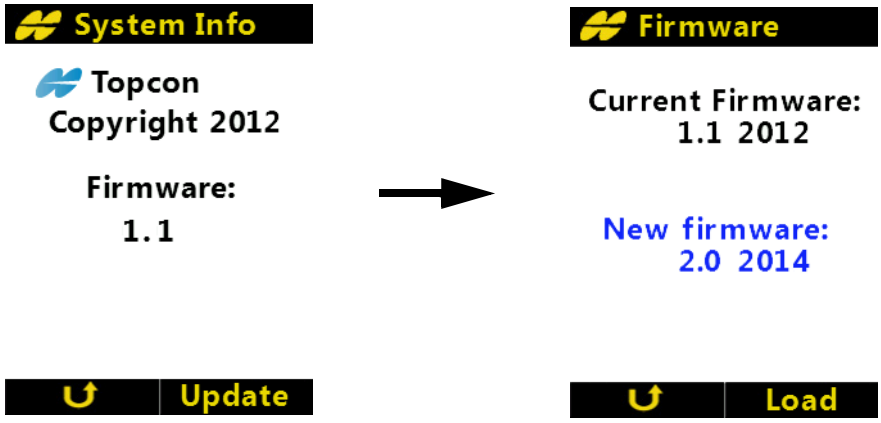


Figure 67: Updating Firmware

5. Wait for several seconds for the firmware update process to complete. The Control Box displays the progress of the update, reboots, and then displays the **Control Screen**.
6. When the **Control Screen** displays, remove the USB key and replace the USB cap, your Control Box is updated and ready to use.

When updating firmware, your settings may revert back to their default values.

Sonic Tracker 3 (P-32+ System only)

Sonic Tracker 3 allows you to select between two detections modes for the ST-3; Surface Mode or Stringline mode. These two detection modes change the sensor's characteristics to optimize the detection zone based on the application.

Surface Mode

Surface Mode is used to detect the ground or curb. While in Surface Mode, the grade indicators display the traditional up/down and ongrade arrows. The Surface Mode icon displays on the Control Screen (Figure 68).

Stringline Mode

Stringline Mode is used to detect an elevated stringline. While in Stringline Mode, the grade indicators display left/right and centered arrows. The Stringline Mode icon displays on the Control Screen (Figure 68).

If you select **Use at power up**, the Control Box powers up in your chosen setting (Surface or Stringline). If not, after shutting down, the Control Box powers up in Surface Mode.

- Display Value Range: Surface, Stringline
- Factory Default: Surface

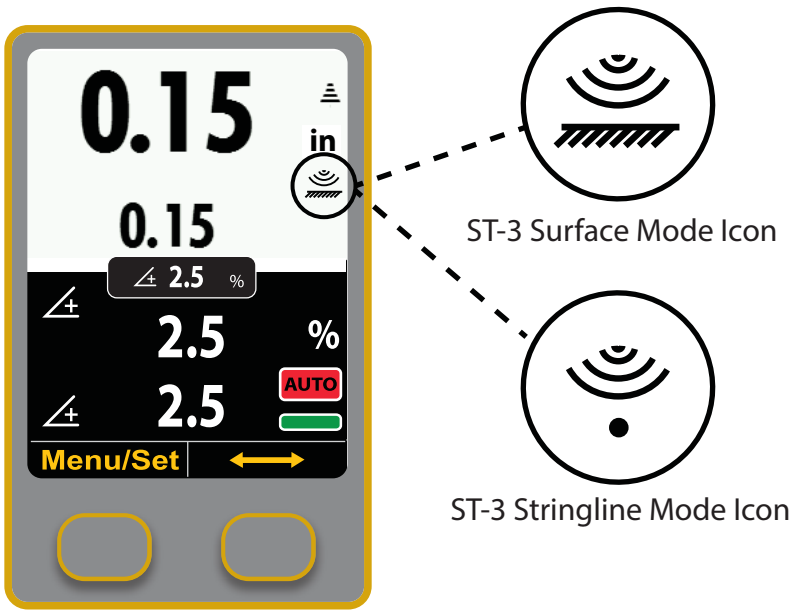


Figure 68: Sonic Tracker 3 - Surface and Stringline Mode

Slope Resolution

Slope Resolution adjusts the slope percentage increment amount (the percentage of slope displayed) on the Control Box.

- Slope Resolution Value Range: 0.1%, 0.05%
- Factory Default: 0.1%

.

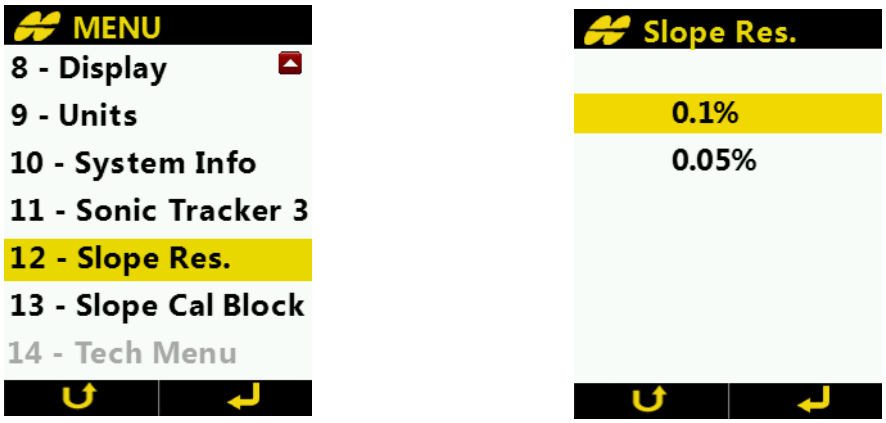


Figure 69: Slope Resolution

Slope Calibration Block

Slope Calibration Block allows you to block the operator's ability to calibrate the slope value from the Control Screen. Pressing the **Menu/Set** button and turning the **Grade Adjustment Knob** will not change the slope value on the Control Screen. This feature prevents you from accidentally calibrating the slope sensor.

Topcon recommends that after turning Slope Calibration Block **Off** and calibrating the slope sensor, that you turn Slope Cal Block back **On** before continuing to work to avoid accidentally calibrating the slope sensor from the Control Screen.

- Slope Calibration Block Range: Off, On
- Factory Default: On

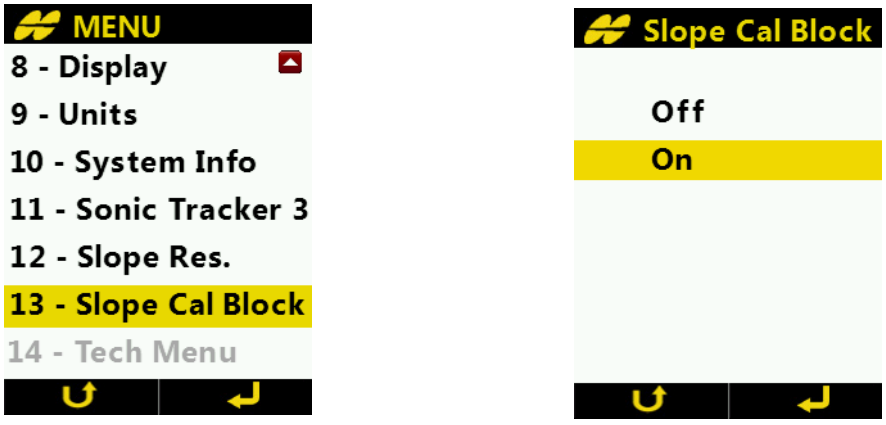


Figure 70: Slope Calibration Block

You can use either the Topcon's ST-3 (P-32+ System) or the Sonic Tracker II (P-32 System) as a sonic control elevation reference for your system. The following sections describe how to set up a Sonic Tracker.

For specifics on each type of Sonic Tracker "ST-3 Specifics" on page 53 and "Sonic Tracker II Specifics" on page 58.

Working Window and Sonic Footprint

Built into the Tracker is an operational zone, or Working Window. The default value is 0.20 ft above and below the grade reference (Figure 71). The grade lights on the Sonic Tracker and Control Box continuously display this grade information to the operator.

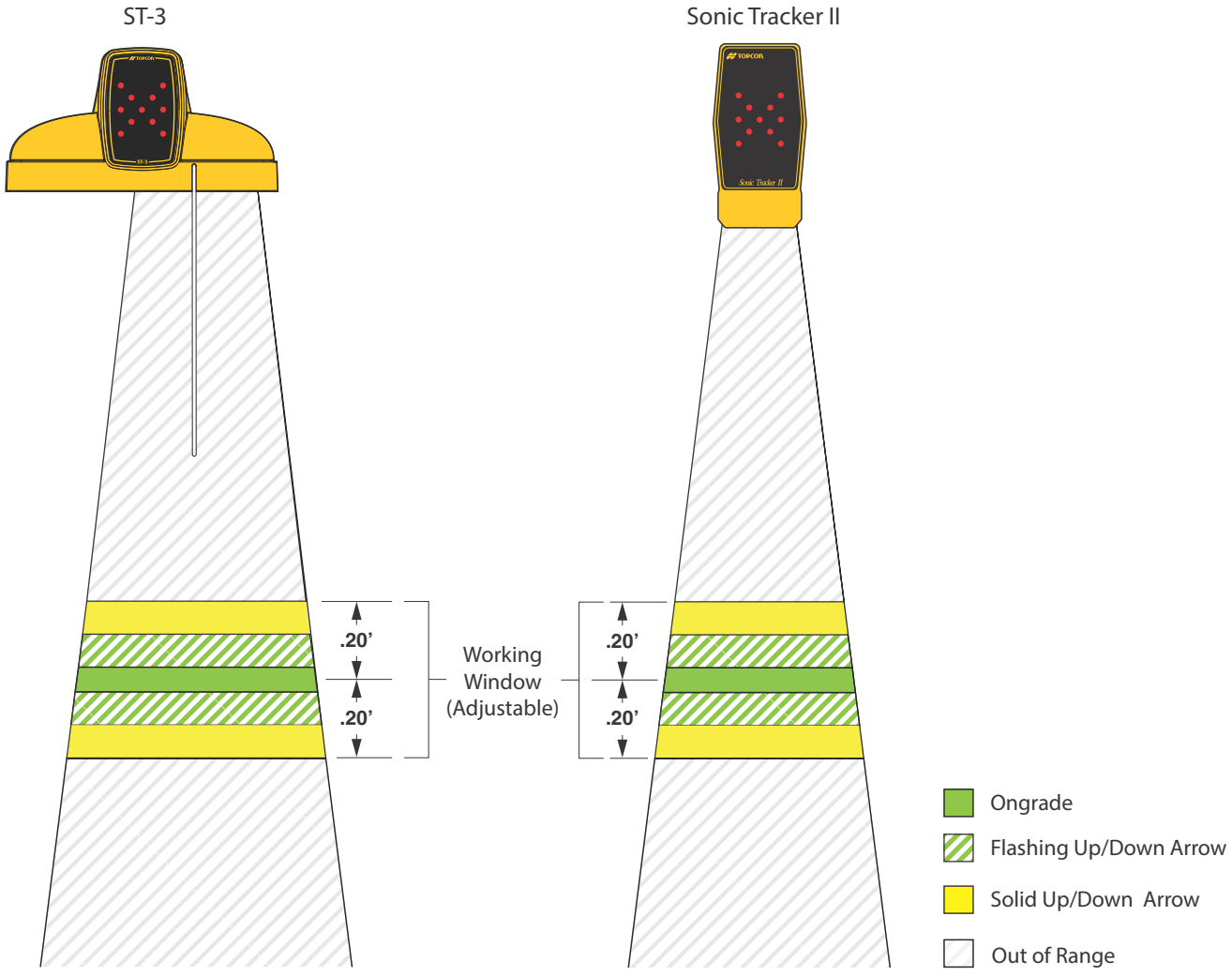


Figure 71: Sonic Tracker Working Window

When setting up the Sonic Tracker over a grade reference, you must consider the size of the Sonic Cone, or Footprint (Figure 72). As an example, at about two feet from the tracker, there is a footprint or cone of about six inches in diameter.
As the Tracker is positioned closer to the grade reference, the Footprint decreases in size. As the Tracker is moving farther away from the grade reference the Footprint increases in size.

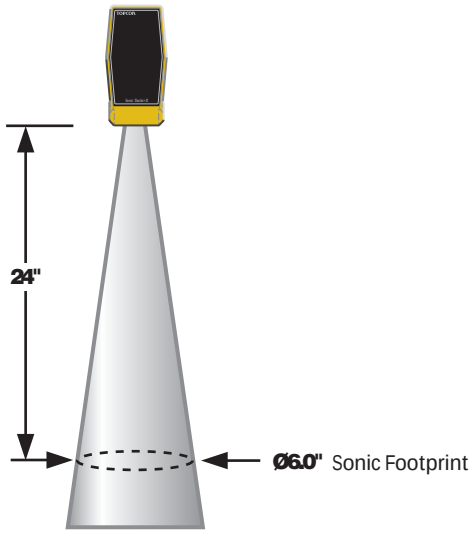


Figure 72: Sonic Tracker "Footprint"

Sonic Tracker Operation and Position

On the paver, the Sonic Tracker II is positioned above the grade reference to maintain an exact distance from the tracker to the reference (Figure 73 on page 43). If the Tracker is On-Grade, the mat being laid is at the desired depth.

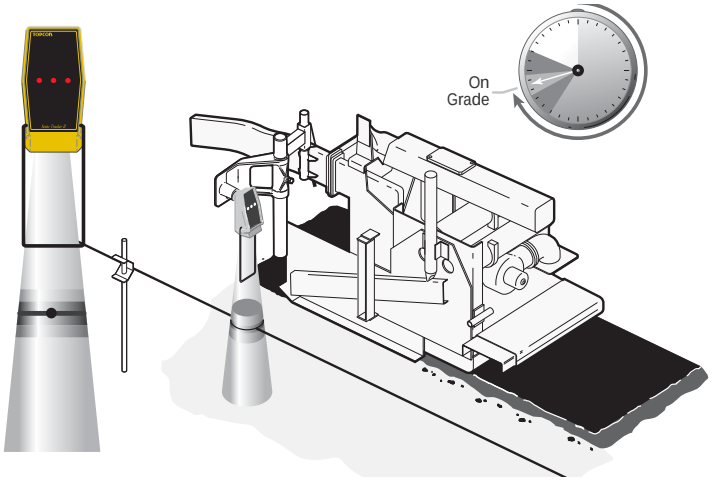


Figure 73: Sonic Tracker On-Grade

If the screed and the Sonic Tracker II start to raise, the watch stops at a longer time (Figure 74). The Tracker and Control Box indicates a down correction arrow, and lower hydraulic valve corrections are applied to bring the Tracker back to On-Grade.

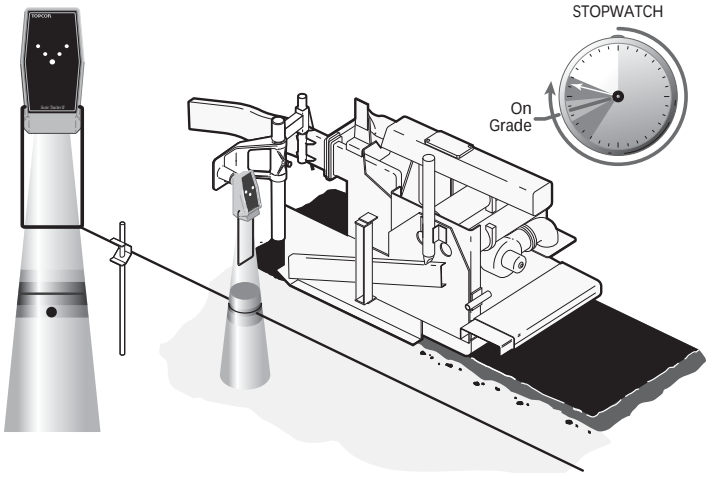


Figure 74: Sonic Tracker above Grade

If the screed and Sonic Tracker II are lowered, the watch stops at a shorter time (Figure 75). The Tracker and Control Box indicate a raise correction arrow, and raise hydraulic valve corrections are applied to bring the Tracker back to On-Grade.

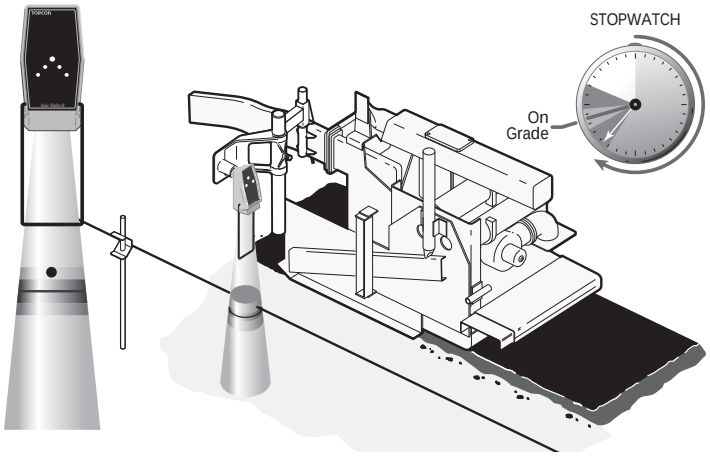


Figure 75: Sonic Tracker Below Grade

If the Sonic Tracker II is side shifted off a stringline, the sound waves reflect off the ground and the Tracker's stopwatch indicate a longer time (Figure 76 on page 45). The Tracker is out of the Working Window, and no On-Grade corrections are applied.

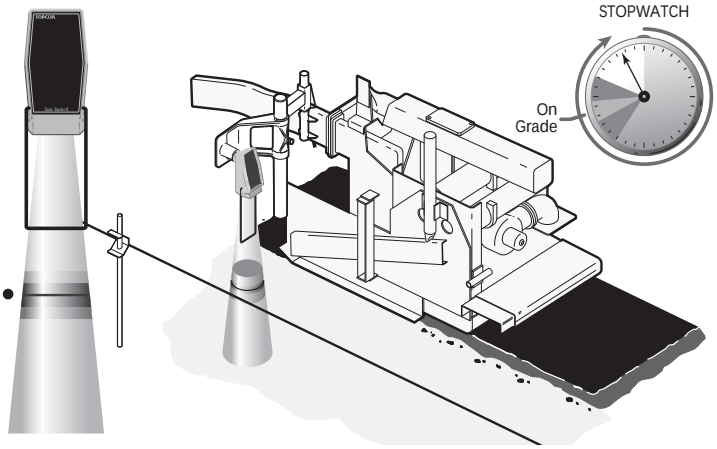


Figure 76: Sonic Tracker Scanning Outside of Stringline

If the Tracker sees an obstruction closer than the reference signal, such as a grade pin, the watch stops at an even shorter time (Figure 77). The Tracker is out of the Working Window, and no On-Grade correction signals are applied.

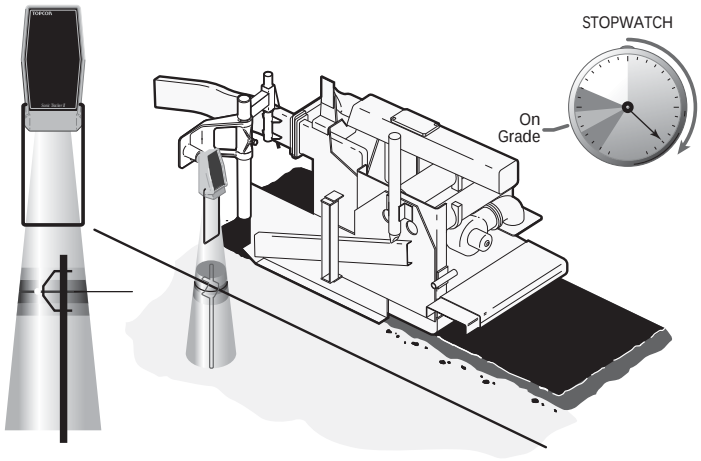


Figure 77: Obstructions within the Sonic Tracker's Working Window

Sonic Tracker and Temperature Changes

Since temperature affects the speed of sound, the Tracker has a built in temperature sensor for applications with gradual temperature changes such as on graders or dozers. In paving applications you can get a more dramatic and rapid change in air temperature. To compensate for these variations a temperature bail is positioned below the tracker.

When the Sonic Tracker's transducer emits a sound wave, the tracker records the time to the bail and continues to listen for the grade reference. If a temperature variation occurs, such as heat off a freshly paved mat, a difference in time to the temperature bail is recorded. The correction for the speed of sound is then applied to the grade reference signal, preventing a change in mat depth. The tracker corrects for temperature variations with every sound wave, 39 times per second. Figure 78 illustrates this concept.

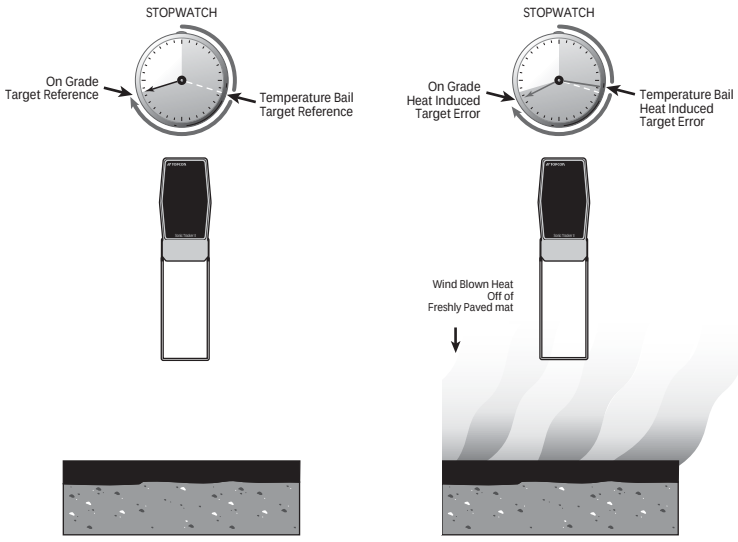


Figure 78: Working with Sonic Trackers and Temperature Changes

In the upper right hand corner of the Sonic Tracker II faceplate is a small symbol used to represent the use of the temperature bail. The LED symbol automatically illuminate when the bail is connected to the tracker. The tracker is cast with holes on each side for the bail to snap and lock into place (Figure 79).

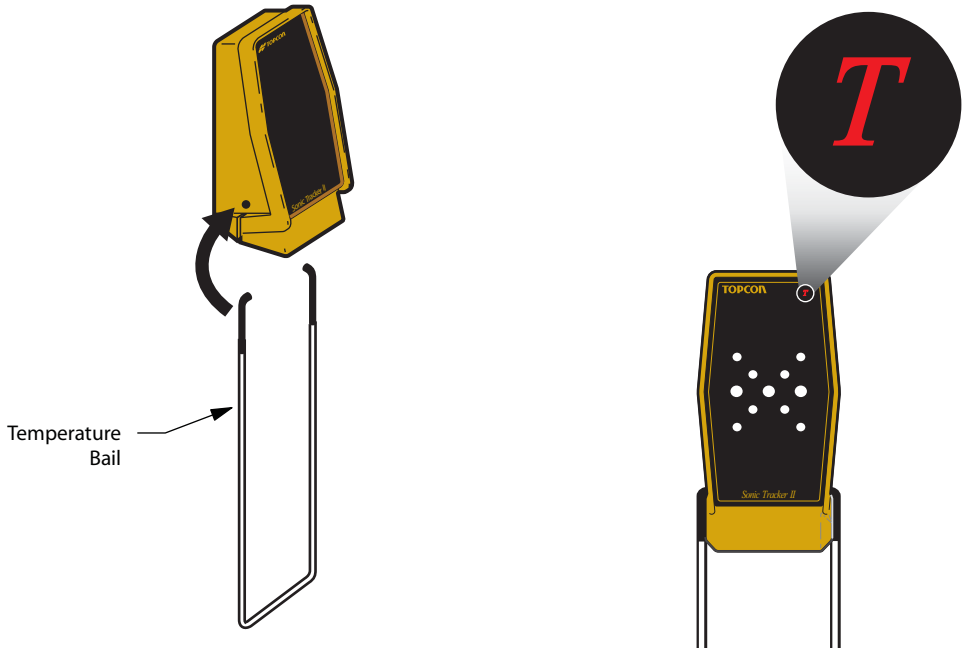
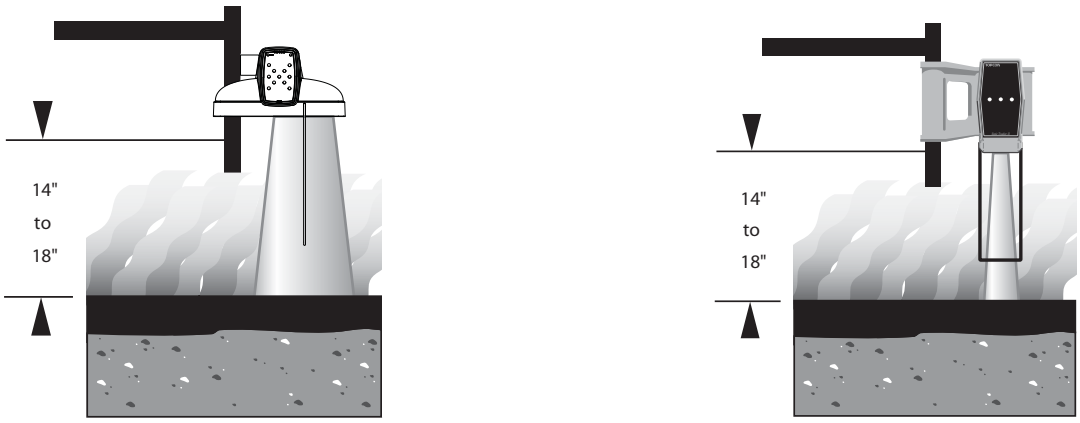


Figure 79: Sonic Tracker and Components

Sonic Tracker Placement

Placement When Using a Temperature Bail

Temperature and atmospheric conditions have an effect on the speed of sound. In paving applications, you can get a dramatic and rapid change in air temperature. A temperature bail is attached to the Tracker to compensate for these variations. If you are on a job where there are high winds and/or large temperature fluctuations, lower the tracker closer to the reference (Figure 80).



ST-3 **Sonic Tracker II**

Figure 80: Temperature Conditions and Tracker Placement

Placement When Using a Mechanical Ski

If using a mechanical ski with an elevated string or wire, make sure the string/wire reference is a minimum of 4 inches above the ski (Figure 81). When paving with a mechanical ski through super elevations, the ski tends to pull away from the paver and may even tip to one side. Elevating the string at least 4 inches ensures that the ski stays out of the working window.

Also, remember to place the Tracker in the center of the ski to maximize the averaging length. If using a 30 foot ski, place the sensor 15 feet from the end of the ski. For every 1 foot positioning error from the center of the ski, you lose 2 feet of effectivity of the ski. For example, if the sensor is moved foreword or backward 2½ feet (12½ feet from the end) you are using a 25 foot ski.

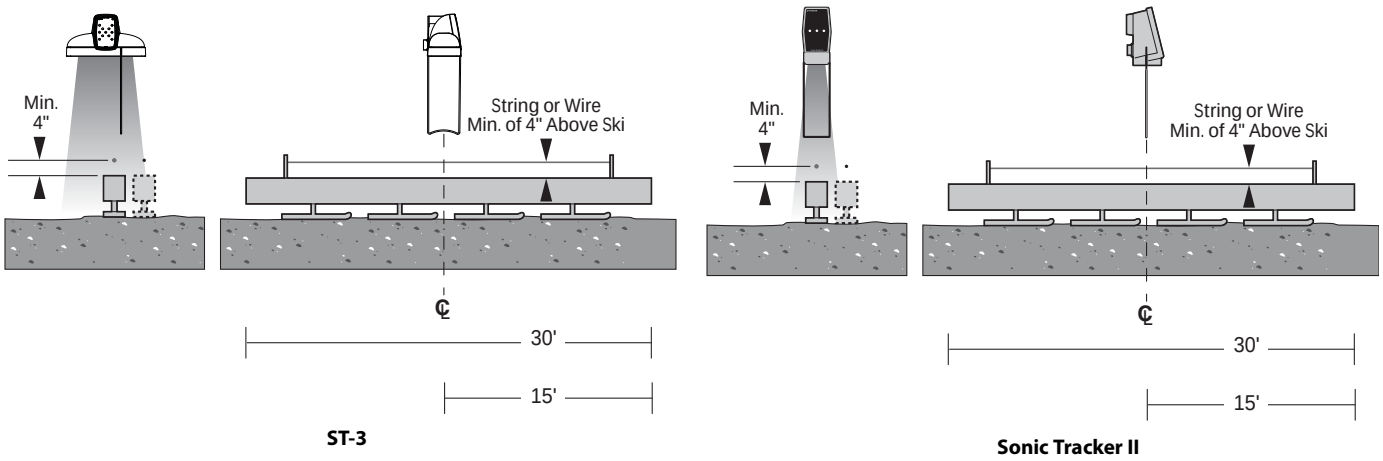


Figure 81: Tracker & Mechanical Ski Placement

Placement When Using Elevated Stringline

Some jobs may require the mat be laid to a specified elevation. In an application like this, an elevated stringline or wire may be set up. The Sonic Tracker has a built in working window that prevents the screed from diving if the tracker loses the stringline reference. Position the tracker over the stringline and set the distance between 18 and 24 inches (Figure 82).

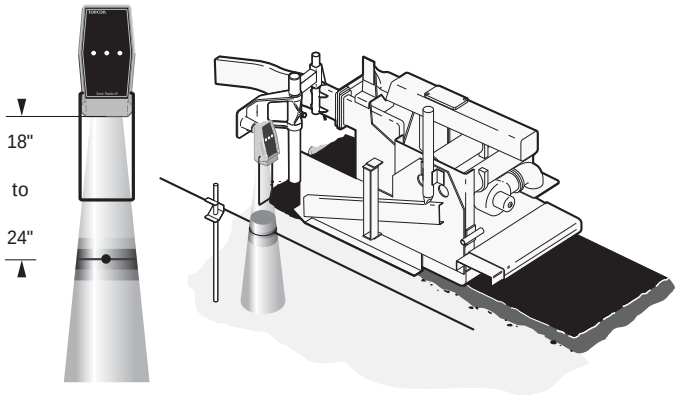


Figure 82: Tracker Position – Mat laid at Specific Elevation

Placement in Relation to the Screed

As a tracker is moved closer to or further away from the screed, the response of the screed to an elevation correction changes. A rule of thumb is to place the tracker about 1/3 to 2/3 the length of the tow arm forward of the screed pivot point (Figure 83 on page 48).

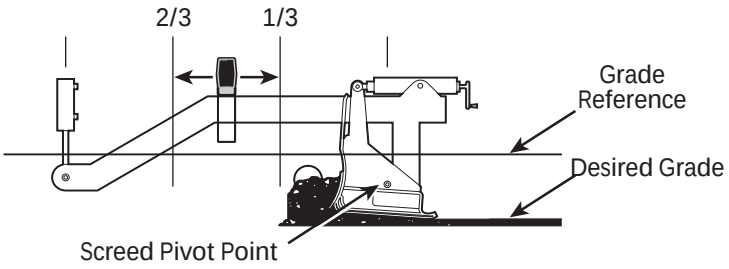


Figure 83: Correct Tracker Placement in Relation to Screed

If the tracker is not placed between these points, then incorrect screed responses could result. The following examples describe the possible, incorrect placements and the errors that would occur.

Example 1: Tracker Placed Incorrectly at Screed Pivot Point If the tracker is placed directly at the screed pivot point (Figure 84), you can see exactly where the screed is relative to the grade reference. However, there is no feedback from the tow point cylinder, which is used to make the grade control changes.

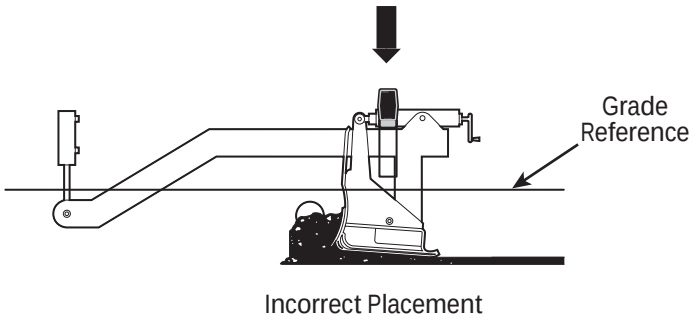


Figure 84: Incorrect Placement at Screed Pivot Point

If the tracker gets closer to the reference, it sends a raise correction signal to the valve and the tow point cylinder begins to move up. Because the screed floats, it does not react immediately to the tow point movement, so the tracker continues to send raise correct signals to the valve. By the time the screed gets to grade (approximately 3 tow arm lengths), the tow point cylinder has moved too far, causing the screed to continue raising. The tracker senses this over correction and sends a lower signal to the tow point cylinder, repeating the whole process in the other direction. Therefore, with the tracker mounted at the screed pivot point, long waves in the mat are produced because there is no feedback from the tow point cylinder to the screed (Figure 85).

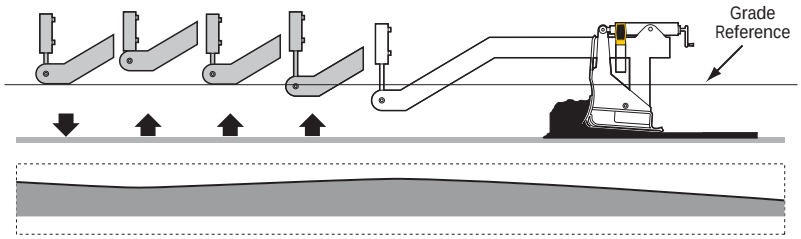


Figure 85: Tracker at Screed Pivot Point Causes Erroneous Corrections

Example 2: Tracker Placed Incorrectly at Tow Point At this point, where grade corrections are being made, the Laser Receiver is kept at an exact distance from the grade reference (Figure 86 on page 49). Any tracker elevation changes cause the tow point cylinder to move immediately. The problem with the tracker placed here is the lack of feedback from the screed.

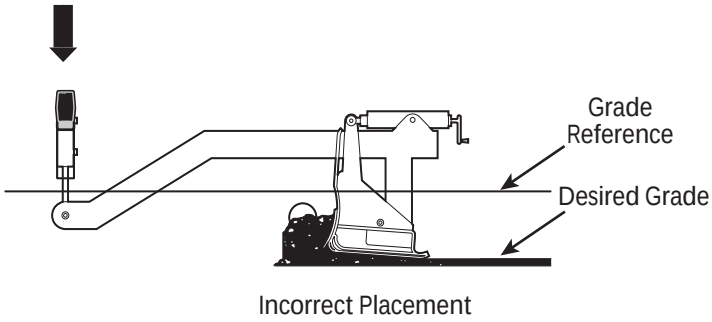


Figure 86: Incorrect Placement of Tracker at Tow Point

If any of the forces acting on the screed change, then the screed rises or falls without the tracker sensing the movement. For example, if the amount of material in front of the screed was decreased, the head of material force (“M”) also decreases and the screed would begin to fall (Figure 87). However, the Tracker would keep the tow point cylinder on grade, but not the screed since there is no feedback.

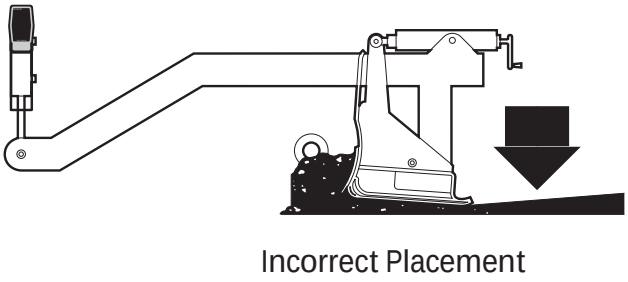


Figure 87: Tracker at Tow Point Causes Erroneous Corrections

The best place for the tracker is in the 1/3 to 2/3 zone, but where do we position the tracker within that area? That depends on what end result of paving you are trying to achieve. As the tracker is moved further back towards the screed it becomes more reactive. At the 1/3 point a 1/4 inch correction at the tracker causes a 3/4 inch correction at the tow point (Figure 88). Another way to look at it is the “Net Tow Arm Length”.

A paver with a 9 foot tow arm and no Laser Receiver takes 27 feet (9 feet x 3 tow arm lengths) to see 96% of the elevation change. If a tracker is placed at the 1/3 point, or 3 feet in front of the screed pivot point, then the paver must move 9 feet (3 feet x 3 tow arm lengths) for 96% of the elevation change. The tracker is measuring the distance to the reference, so its position along the tow arm becomes the “net tow arm length”. A more reactive screed would be beneficial for applications where it is important to match the reference, such as tracking a curb and gutter or matching a joint.

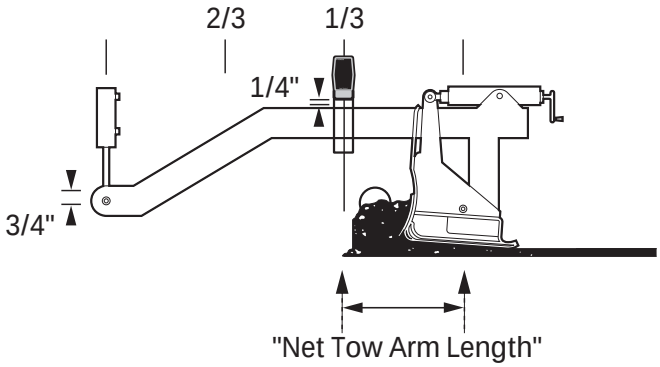


Figure 88: Correct Placement of the Sonic Tracker

As the tracker is moved further forward the screed becomes less reactive. A tracker placed at the 2/3 point and looking for a 1/4 inch correction only causes the tow point to move 3/8 inch. The net tow arm length is now 18 feet (6 feet x 3 tow arm lengths). This would be a better tracker position for applications where smoothness is desired such as mainline paving or when using a mechanical or non-contacting (SAS) ski.

L-Bar Positioning

Position the L-Bar horizontally so the tracker is over the reference. For example, when tracking a curb and gutter, place the screed or extension flush with the edge of gutter and slide the L-Bar so the Tracker is over the lip of the gutter (Figure 89).

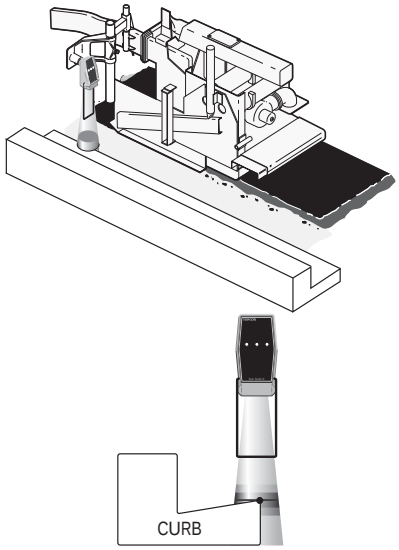


Figure 89: Positioning the L-Bar with Tracker

The L-Bar can also be mounted to a bracket on the screed extension (Figure 90). This would work well in applications where the reference is not a constant width and requires the extension to be moved in and out. Mounting to the extension makes it easier to keep the tracker over the reference.

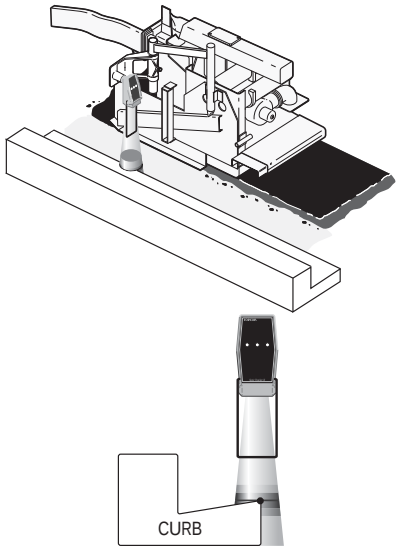


Figure 90: Position of L-Bar with Tracker on Bracket

Curb and Gutter Tracking

When tracking a curb and gutter, keep the tracker 14 to 24 inches above the lip of gutter (Figure 91). If the tracker is placed too high, the sonic cone may pick up an unwanted surface, such as the face of the curb.

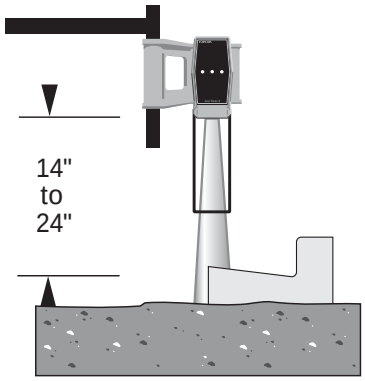


Figure 91: Tracking a Curb and Gutter

If you are paving around a tight curb using an ST-3, make sure to orient the ST-3 in-line with the direction of travel (Figure 92).

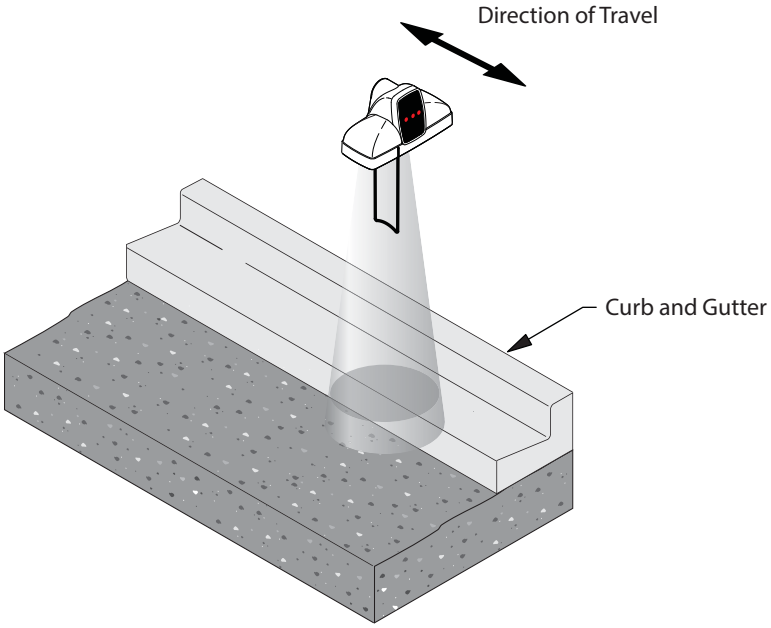


Figure 92: ST-3 Direction of Travel - Tracking Curb and Gutter

Joint Matching and Tracking Sub-grade

For joint matching and tracking sub-grade or most surfaces keep the tracker between 14 to 24 inches (Figure 93). A good rule of thumb is to set the tracker about 18 inches from the reference.

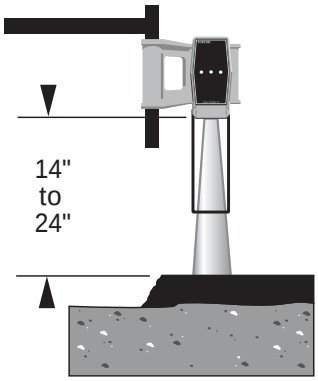


Figure 93: Joint matching & Tracking Sub-Grade

ST-3 Specifics

The ST-3 has two detection modes to ensure the best accuracy possible as well as changing sensor characteristics to optimize the detection zone based on application. The two modes are Surface Mode and Stringline Mode.

Setting Surface or Stringline Mode for the ST-3

When using a Sonic Tracker 3 (ST-3), you can select either **Surface** or **Stringline** mode from the **Performance Menu**. Use Surface mode when tracking a surface, or Stringline when tracking a stringline with your ST-3. By checking the **Use at power up** check box, the Control Box remembers your preferred setting at power up. The default setting is Surface.

1. From the **Performance Menu** select **Sonic Tracker 3** and press the press the **Enter** button .
2. Press either **Surface** or **Stringline**.
3. Check the **Use at power up** check box to lock this setting when the Control Box powers on and off, if desired.

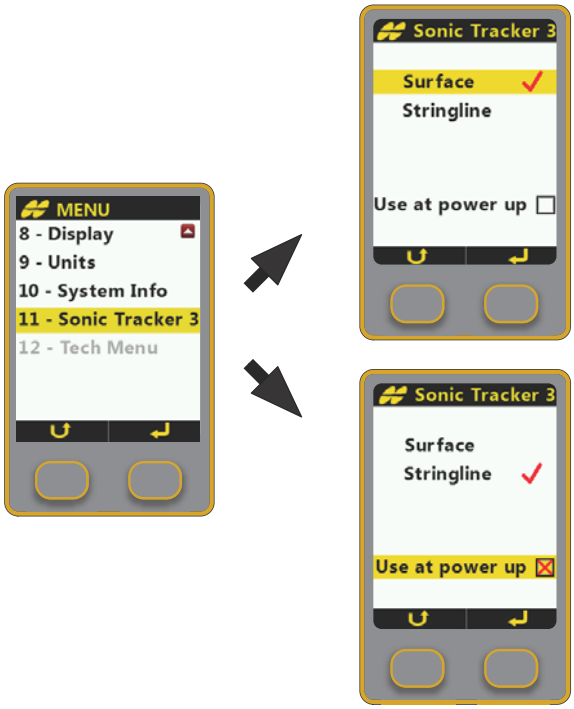


Figure 94: Selecting Surface or Stringline Mode

ST-3 Orientation

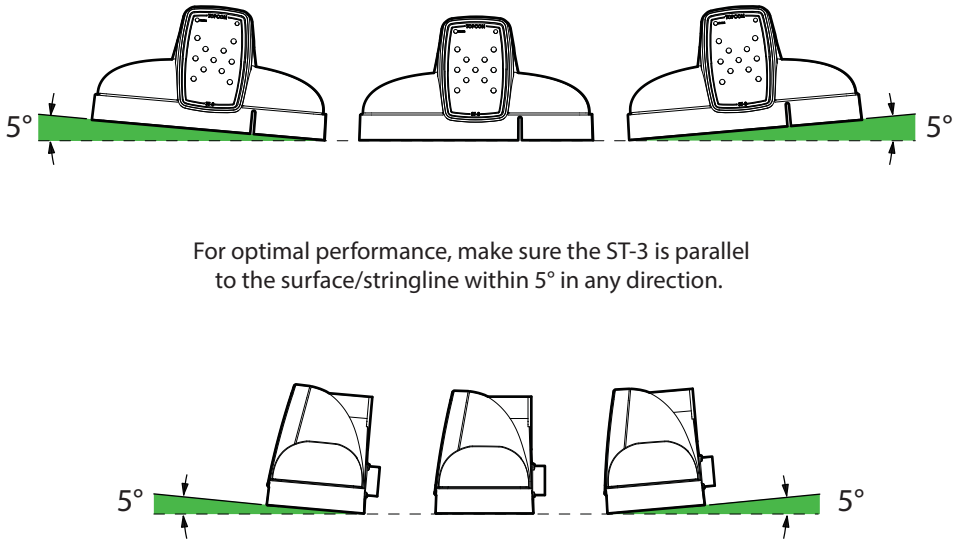


Figure 95: ST-3 Orientation

Surface Mode

Surface Mode is used to detect the ground or curb. While in Surface Mode, the grade indicators display up/down arrows and On-grade (centered) LEDs.

Typically, the direction of travel is not critical while in Surface Mode, unless you are paving around a tight curb.

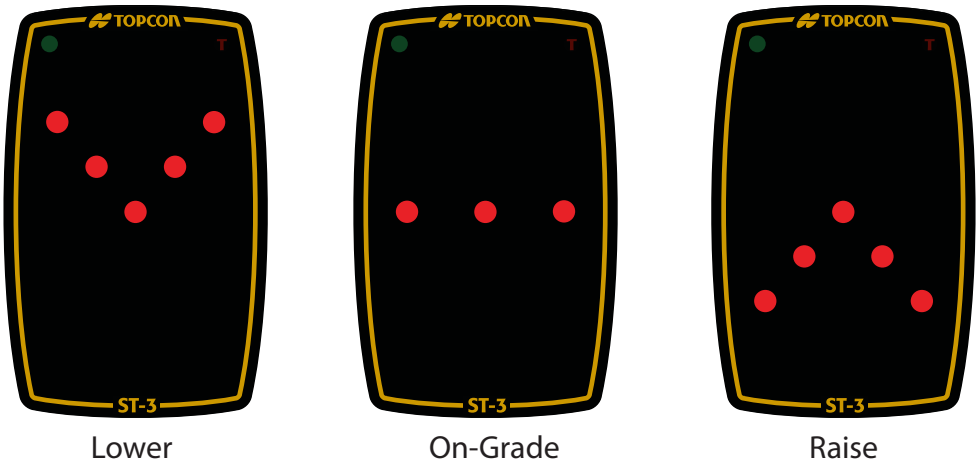
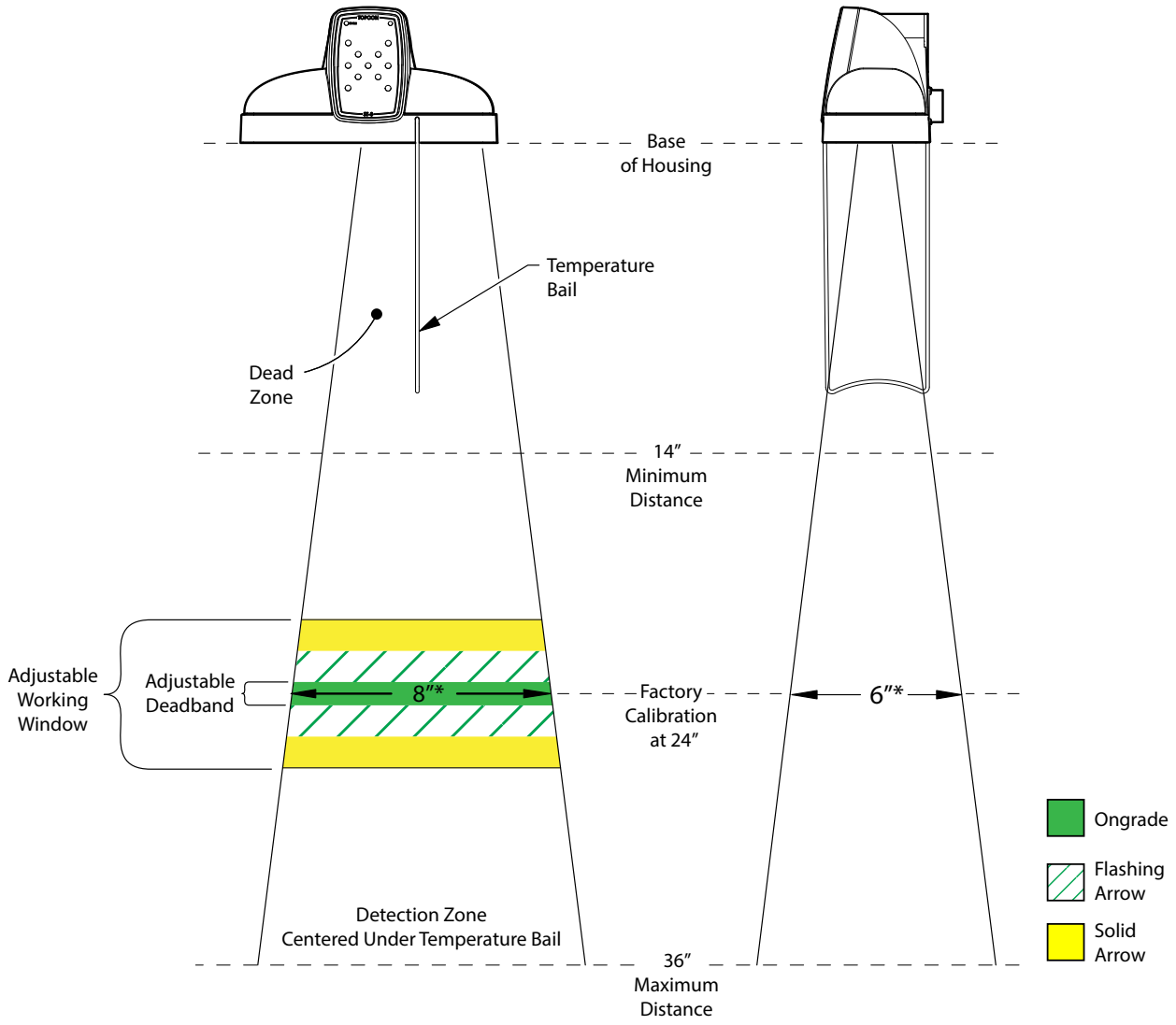


Figure 96: ST-3 Surface Mode LEDs



*Simplified representation of detection zone. Actual range may vary slightly.

Figure 97: ST-3 Surface Mode

Stringline Mode

Stringline Mode is used to detect an elevated stringline. While in Stringline Mode, ST-3 indicates the location of the stringline by using left/right arrows and centered (above stringline) LEDs. The ST-3 LEDs help guide the operator to manually shift the screed in/out.

Figure 98: ST-3 Stringline Mode LEDs

In Stringline Mode make sure the ST-3 is oriented in-line with the direction of travel. (Figure 99).

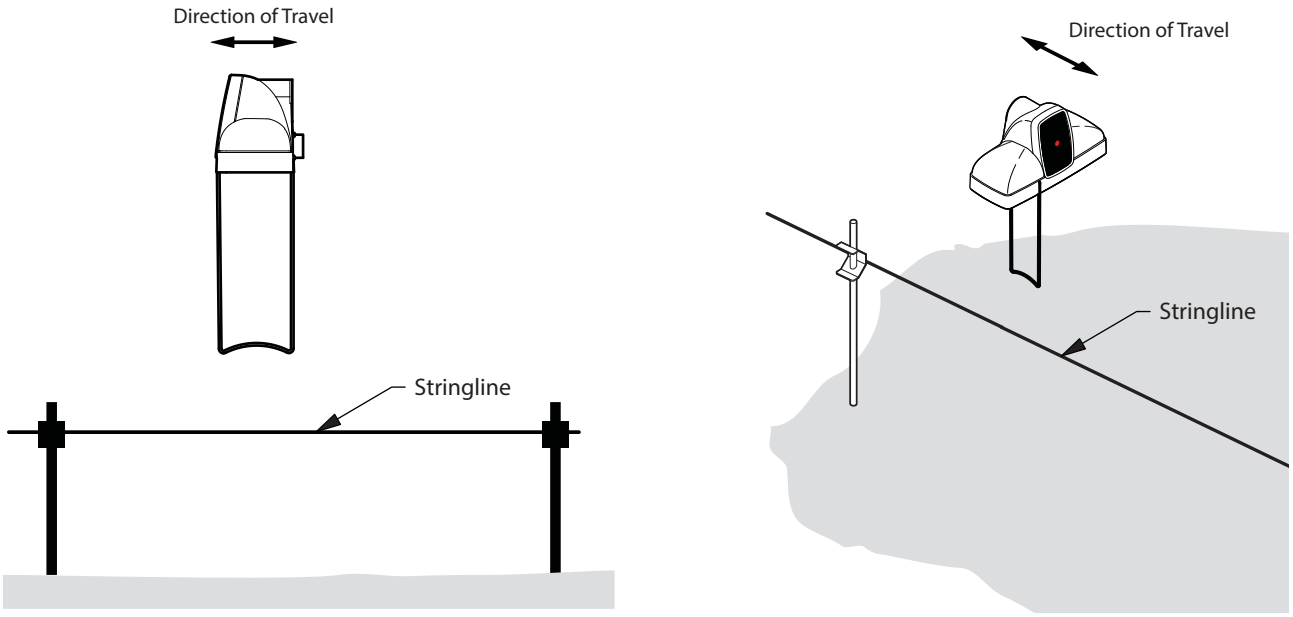


Figure 99: ST-3 Stringline Mode Direction of Travel

The ST-3 cannot detect a surface stringline. You must use an elevated stringline.

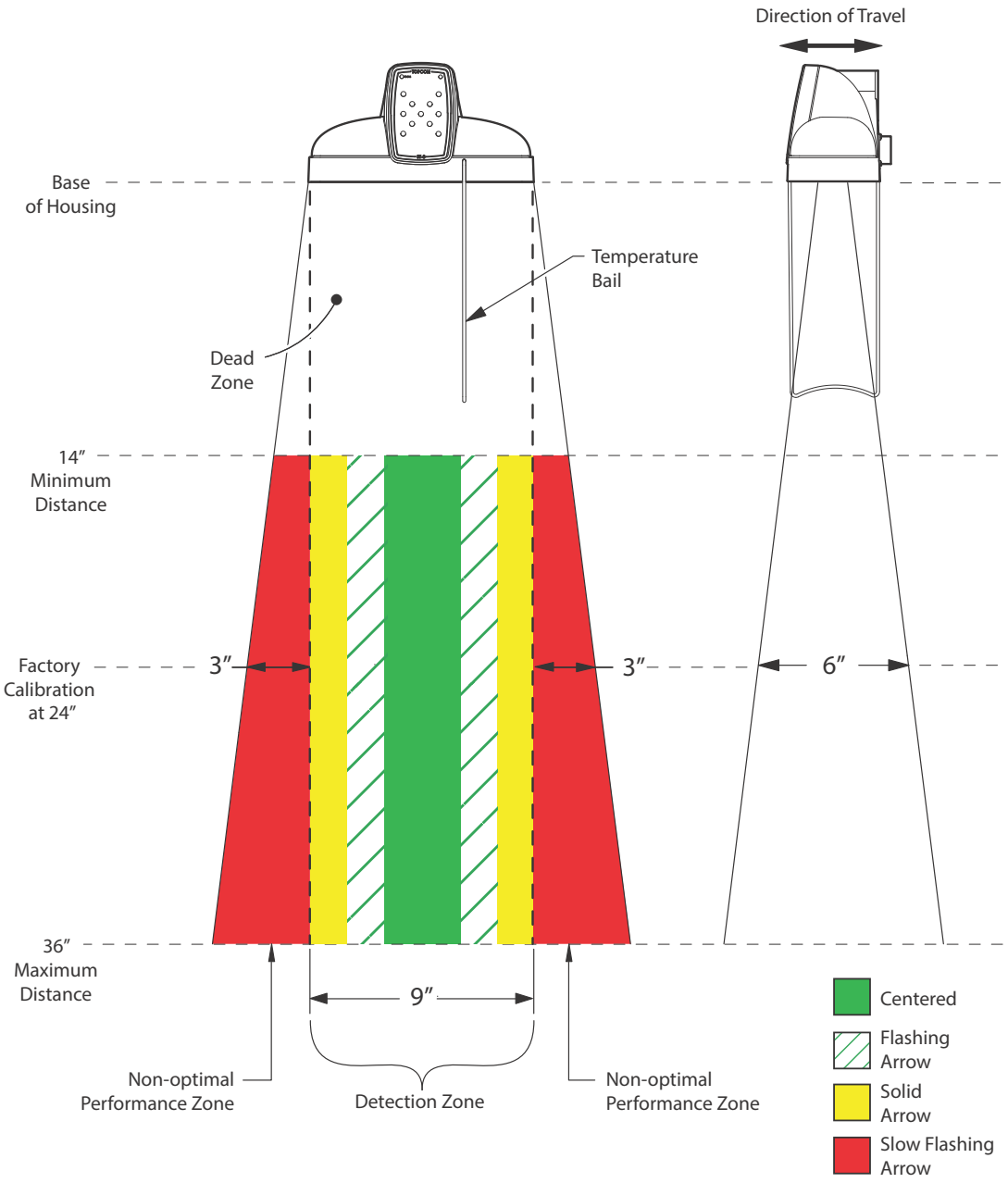


Figure 100: ST-3 Stringline Mode

ST-3 Orientation

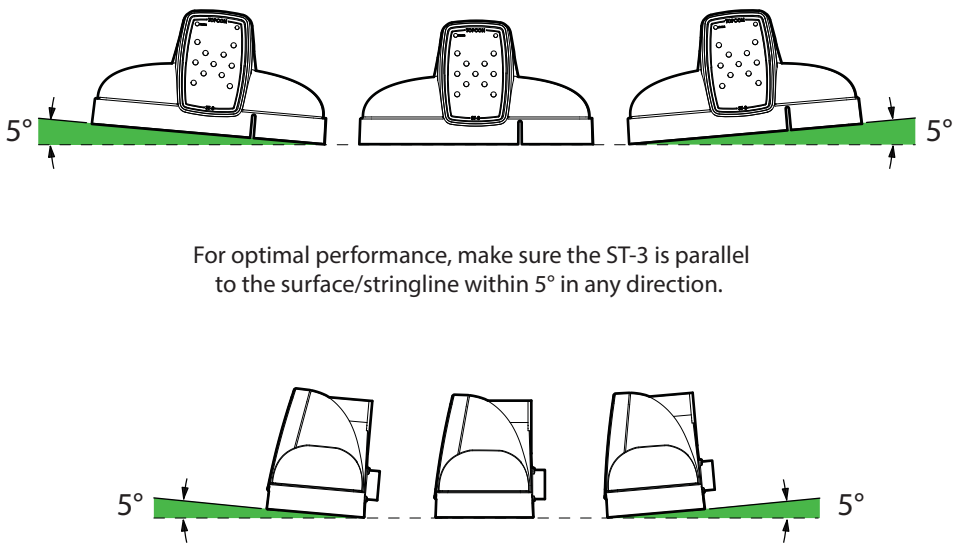


Figure 101: ST-3 Orientation

Sonic Tracker II Specifics

Whether setting up a standard Sonic Tracker II system or a Smoothtrac SAS using the Sonic Tracker II, consider the following for each Tracker:

- The Tracker has a total working range of 14 inches to 55 inches—41 inches of adjustment—allowing the Tracker to be set over a stringline on one pass, then match grade on the next pass without moving the tracker.

  Therefore, the job application determines the position of the Tracker. For example, when using a stringline reference, keep the Tracker about two feet above the string, giving the operator about six inches of lateral movement to keep the Tracker over the string. When tracking a curb, lower the Tracker to keep it over the lip of the curb, preventing the Tracker from “seeing” the top, or face, of the curb.
- When setting up the Tracker over a grade reference, consider the size of the Sonic Cone, or the “footprint”. For example, at about two feet from the Tracker, the footprint, or cone, will be about six inches.
- The Tracker compensates for temperature changes only within the bail range. Placing the Tracker too far from the reference may cause inaccurate temperature compensation.
- Temperature and atmospheric conditions affect the speed of sound. In paving applications, the air temperature can change rapidly and dramatically. A temperature bail attached to the tracker compensates for these variations. If the jobsite has high winds and/or large temperature fluctuations, lower the Tracker closer to the reference.

The following sections detail the positioning tracker in relation to the grade reference, as well as on the machine.

Sonic Tracker II Positioning in Relation to Reference

Raise or lower the tracker bracket to position the tracker at the proper height above the grade reference (Figure 102). The tracker has a total working range of 14 to 55 inches. For paving applications the recommended working height would be from 14 to 24 inches. At 55 inches the sonic footprint would be very large and the tracker may pick up an undesired reference. The tracker also compensates for temperature changes only within the bail range. Placing the tracker too far from the reference may not allow for accurate temperature compensation.

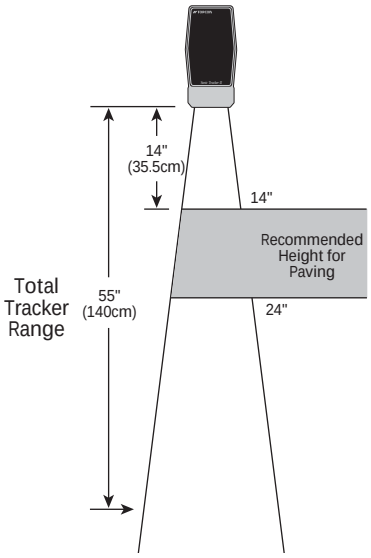


Figure 102: Recommended Sonic Tracker II Placement

Placement When Using Surface Stringline

Sometimes the surface to be paved contains pot holes or the surface is too broken up to use as a joint match reference. Setting an elevated stringline is too time consuming, especially for small, divided up projects. In these applications, surface stringline would be a good alternative (Figure 103). See “Setting Surface Stringline” on page 23 for further details.

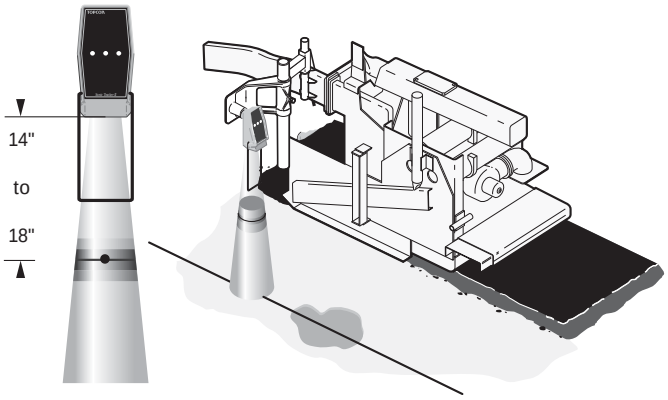


Figure 103: Sonic Tracker II Placement – Pot Holes

Optional Smoothtrac SAS Placement and Setup

Topcon's Smoothtrac® Sonic Averaging System (SAS) is a non-contacting averaging system that uses multiple Sonic Trackers (ST-3 or Sonic Tracker II) to smooth out the bumps and dips in a mat surface (Figure 104). The non-contacting design allows full maneuverability of the paver when turning around, backing up or passing over obstacles without lifting or removing the beam. The screed man can adjust mat thickness on the Slope Sensor while standing on the screed. The Smoothtrac is mounted to the tow arm of the paver, and connects to your Topcon P-32+ or P-32 System with the same coil cord used for the Sonic Tracker.

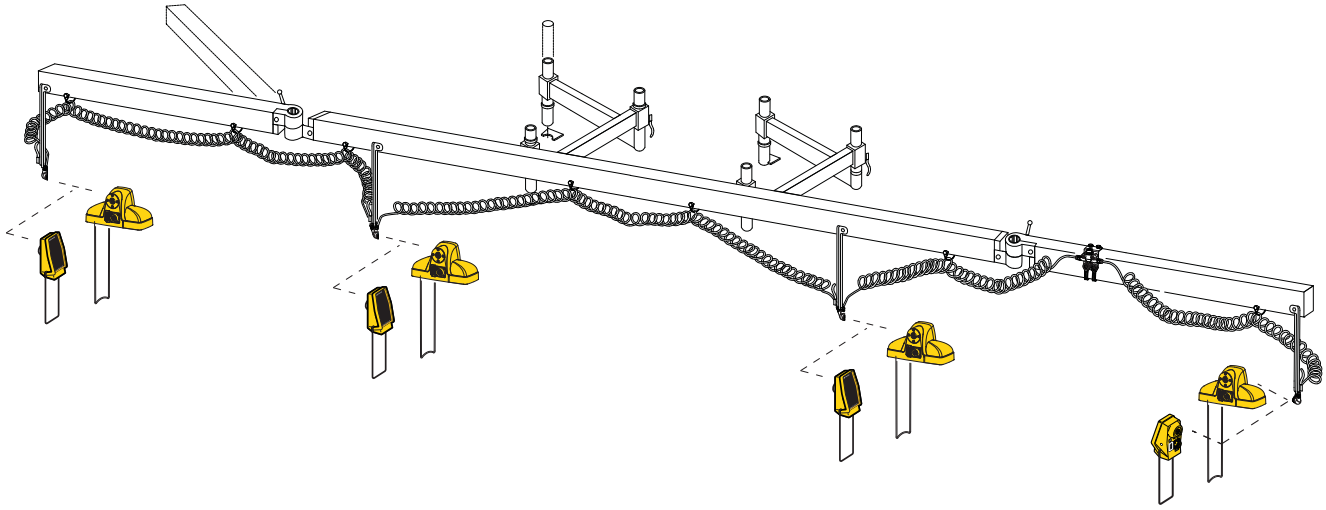


Figure 104: Smoothtrac SAS

When mounting the SAS to the paver, follow these simple steps:

1. If the ski is in pieces, connect them together (Figure 105).

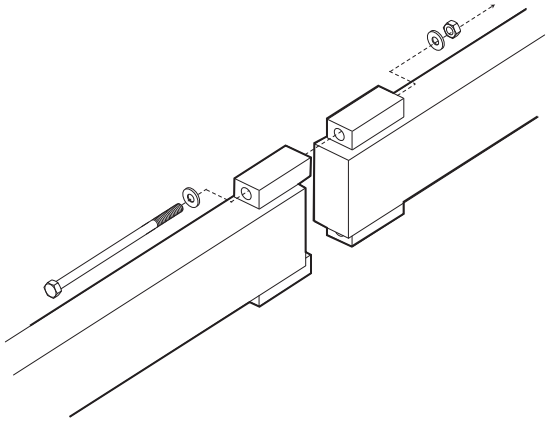


Figure 105: Connecting SAS Pieces

2. Next, mount the L-bars to the brackets on the tow arm. The outside L-bar can be attached so it points up or down. The position depends on how tall the tow arm is off the ground.
    - For pavers with a tall tow arm, mount the L-bar in the downward position.
    - For shorter tow arms, mount in the upward position.

    Place locking collars on the bars and adjust so they are parallel with one another before tightening with an Allen wrench. This allows the ski to move freely when adjustments need to be made without falling off.

3. Bend the L-bars so they are aligned in the same position and fold inwards so they are close to the paver (Figure 106). Make sure the clamp handles are loose so the bars can move.

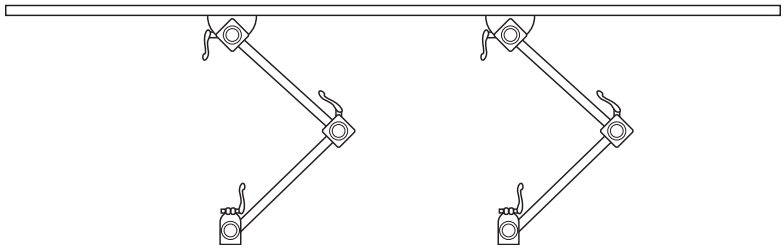


Figure 106: Position of L-bars

4. Lift the ski and slide it over the L-bars. Adjust the ski so it is approximately 2 1/2 feet off the ground. Slide the locking collar up to the ski and lock in place.

The ski is easier to mount if the end beams are folded in. Bend the L-bars so they are aligned in the same position and fold inwards so they are close to the paver. Make sure the clamp handles are loose enough so bars can move.

5. Lower each of the Tracker hangers on the SAS and mount a Sonic Trackers using the L-handle bolt (Figure 107). An extra washer may need to be added so the L-handle does not block the cable connection.

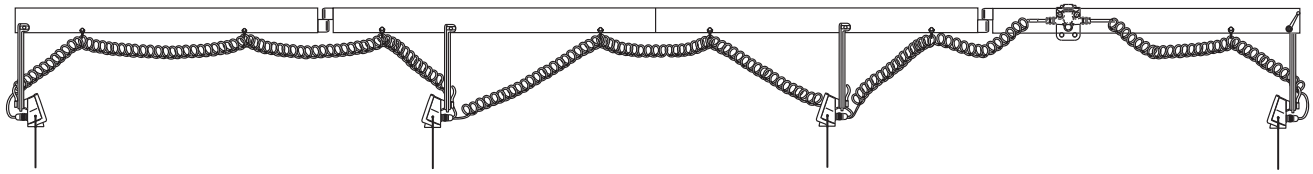


Figure 107: Mounting Sonic Trackers to SAS

6. Connect the SAS coil cable to each tracker (Figure 108).

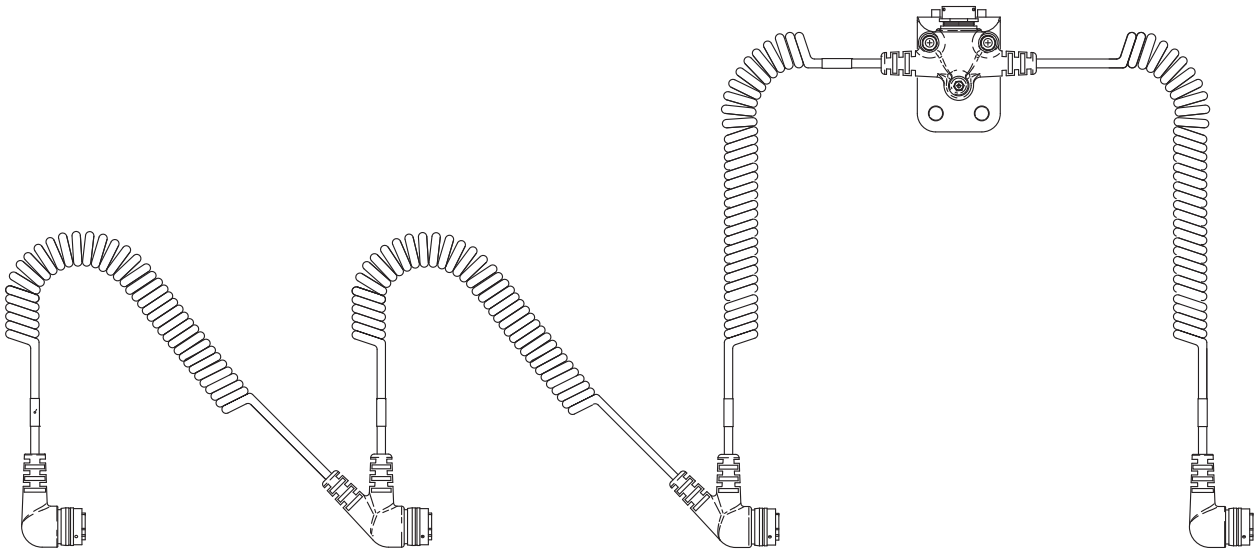


Figure 108: SAS Cable Connectors to Sonic Trackers

7. Attach temperature bails to each tracker and begin paving.

Positioning the SAS

The SAS should be positioned so the Sonic Trackers are 14 to 24 inches from the grade reference (Figure 109). As with single tracker operation, the “lower the better” is a good rule of thumb for paving applications. This helps to minimize the variable temperature conditions that can cause erratic signals. The beam does not have to be perfectly level because each tracker averages the distance to the reference individually.

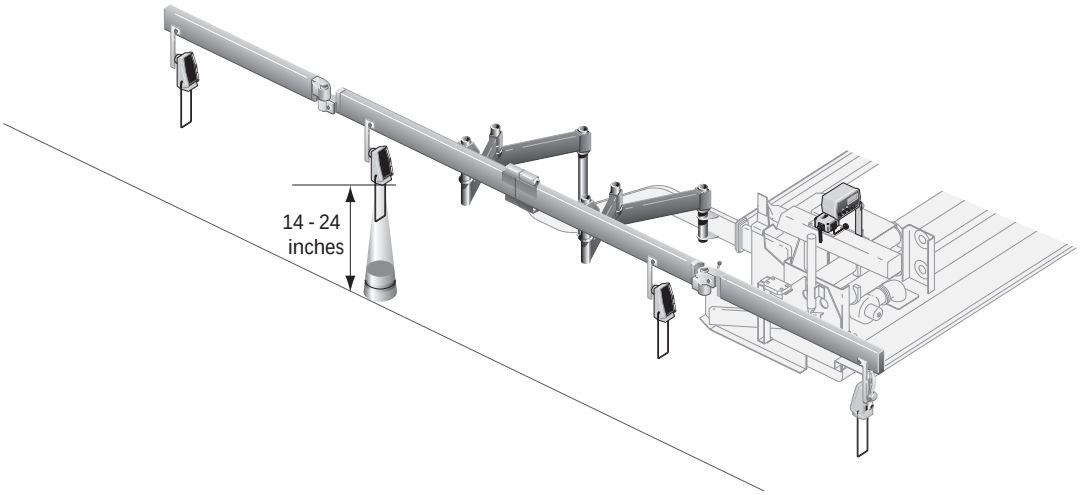


Figure 109: Positioning SAS

The trackers can be placed so all four are over the reference, or the back tracker can be set over the freshly laid mat. The best method is the one you are presently using or the one in which you are most comfortable (Figure 110).

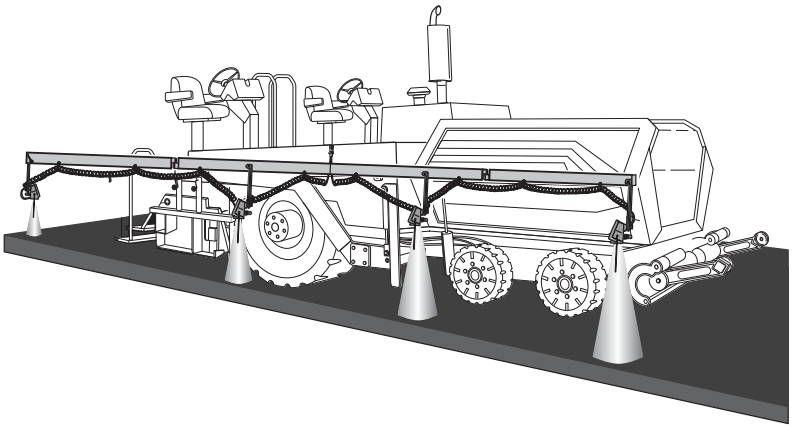


Figure 110: Example Placement of SAS Trackers Over Reference

With SAS, be careful when the screed is raised that the front tracker does not hit the ground. If needed, the tracker bracket can be temporarily folded back when raising the screed to keep the tracker from hitting obstructions (Figure 111).

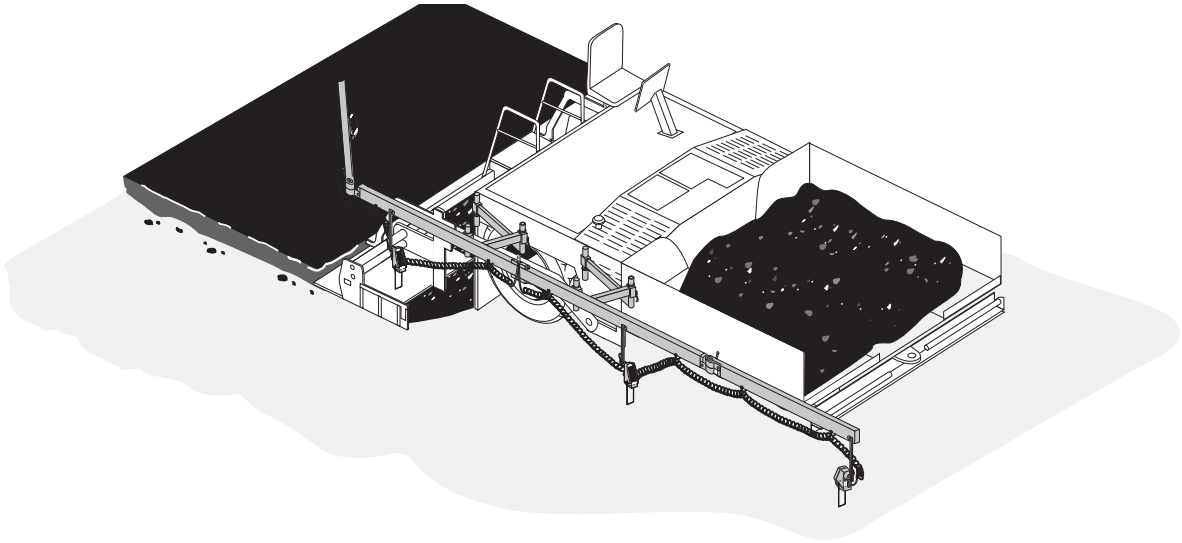


Figure 111: Example of Raising the Tracker Bracket to Avoid Obstructions

In some applications, a grade reference outside the screed extension may not be in satisfactory condition, such as the shoulder of a road or the broken and warped edge of pavement. Traditionally, the screedman would manually adjust mat thickness on that side of the paver. The non-contacting SAS can be set up over the screed so full automation can be used. The first three trackers reference the existing grade and the back tracker references the mat just laid (Figure 112).

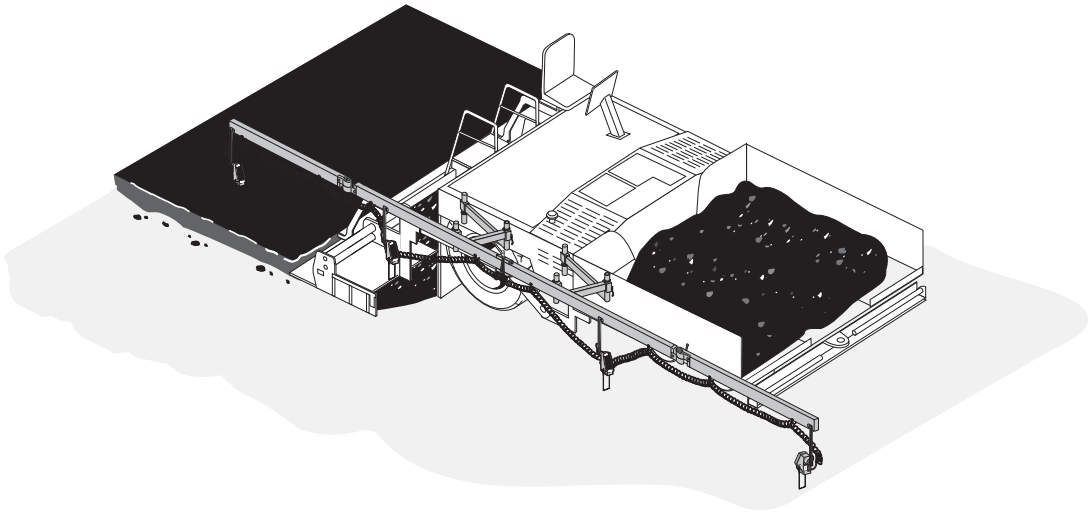


Figure 112: SAS Setup when Screed Extension is Unsatisfactory

When paving with the screed extensions out, there may be a large “head of material” which could be picked up by the Sonic Tracker. If this happens, determine how far forward the tracker must be placed on the beam to not pickup the mix and drill a new mounting hold for the tracker hanger (Figure 113 on page 64). The SAS coil cable easily reaches the tracker.

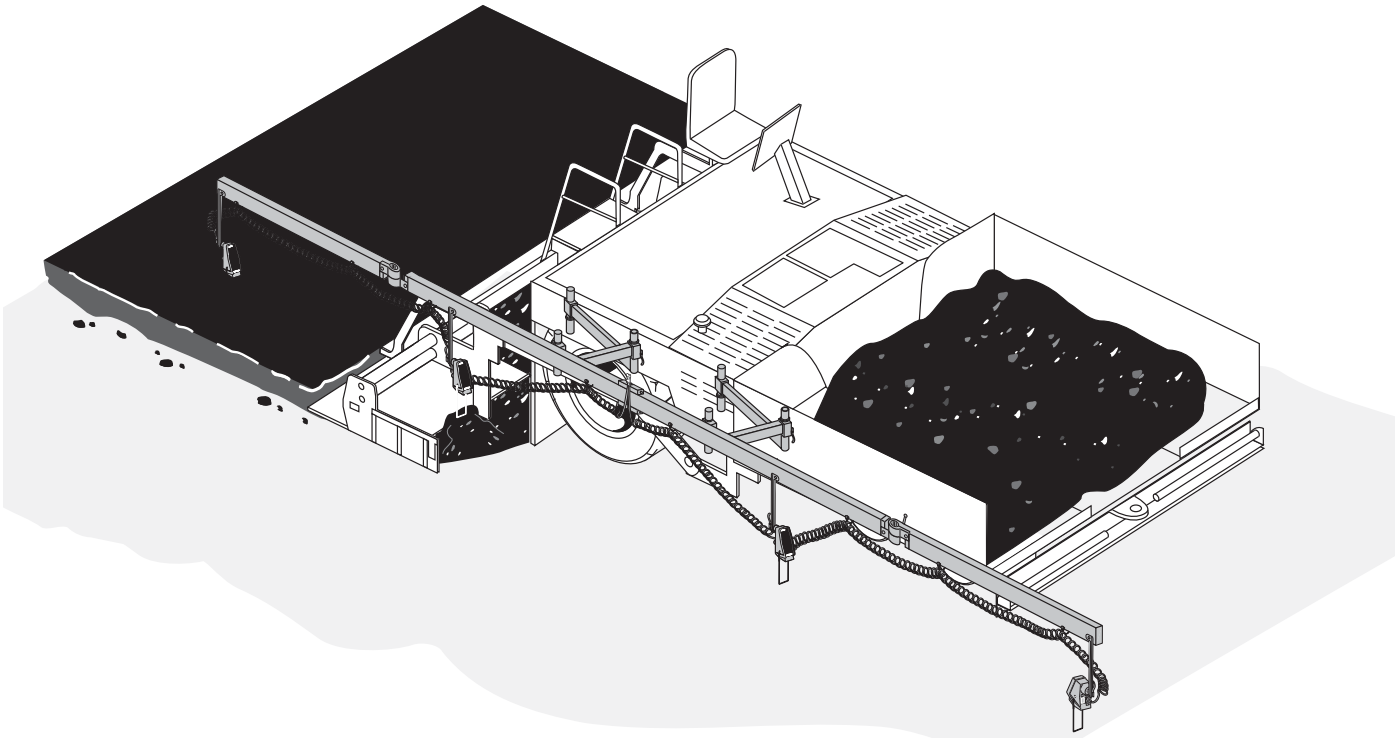


Figure 113: Repositioning the Sonic Tracker

Placement of SAS on Paver

The center connection point of the SAS is the balance point. The position of the balance point to the tow arm is very critical. By moving the balance point, the performance of the system is greatly affected. The balance point of the beam should be located 1/3 to 2/3 the distance from the pivot point of the screed to the tow point cylinder.

Placing the balance point closer to the 2/3 point (near the tow point cylinder), causes the system to have a slower reaction time. This would be good for smoothness or for mainline paving. Placing the balance point near the back 1/3 (closer to screed) causes the system to have a faster reaction time. This would be good for a combination of smoothness and joint matching.

To determine where to position the SAS on the paver, start by measuring the length of the tow arm. Divide the total length by three. This gives you the placement of the balance point of the SAS on your machine (Figure 114).

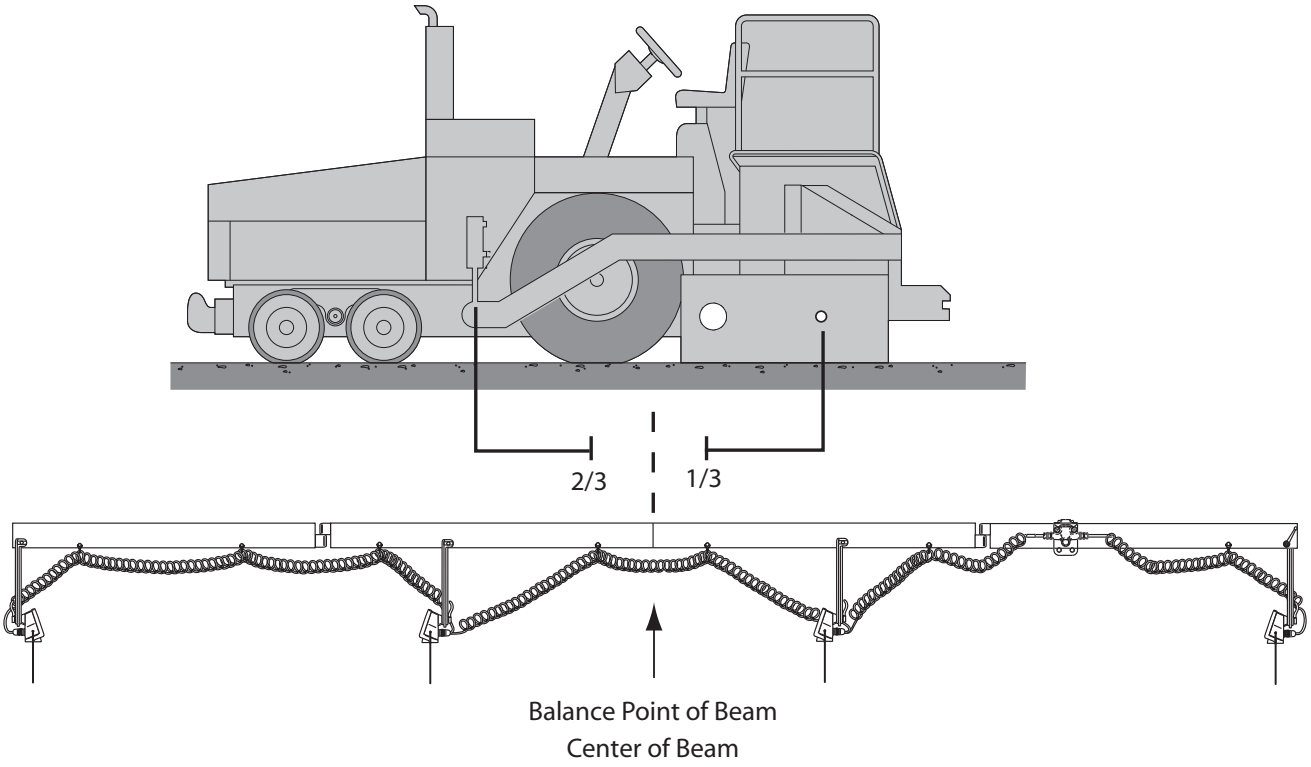


Figure 114: Placement of SAS

This chapter is designed to get the paving crew started using your Topcon P-32+ or P-32 System. The job application and the desired results determine what type of non-contacting controls should be used; i.e. sonic, slope, laser and SAS.

- For Sonic Tracker and SmoothTrac SAS setup, first attach the Sonic Trackers, then setup the Control Box.
- For Slope Sensor setup, first attach and power up the Control Box, then check the sensor's calibration to ensure correct grade.
- For Laser Tracker setup, first setup the laser transmitter, attach the Laser Tracker to the machine, then setup the Control Box.

The components should be mounted on the paver and then the paver itself must be properly set up.

Control Box Setup

Use the following steps to install the Control Box (Figure 115).

1. Attach the Control Box to the Control Box Bracket.
2. Connect the cables to the Control Box.
3. Turn on the Control Box.

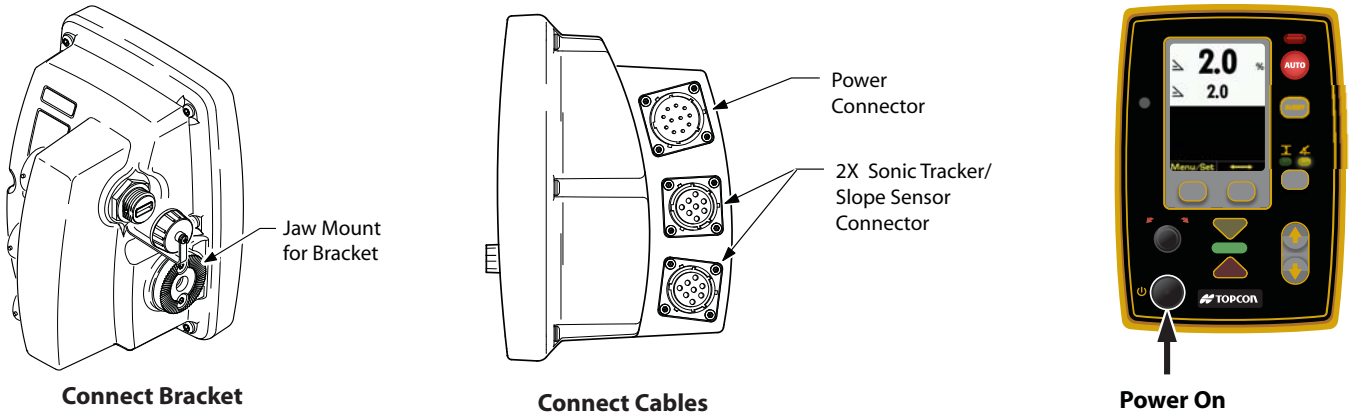


Figure 115: Attach Control Box and Connect Cables

Due to different types of machine configurations, cable connections may vary.

Screed Setup

To start paving with your Topcon P-32+ or P-32 System, set up the paver just as you would under manual control.

1. Place the screed on blocks or lath set for the desired paving thickness (Figure 116); make sure to account for material compaction.

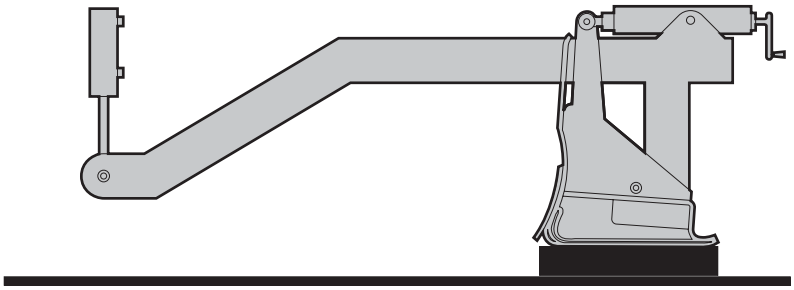


Figure 116: Place Screed on Blocks

2. Center the tow point cylinders to maximize travel in raise or lower directions (Figure 117): use the jog switch on the Control Box or the switch provided with the Paver.

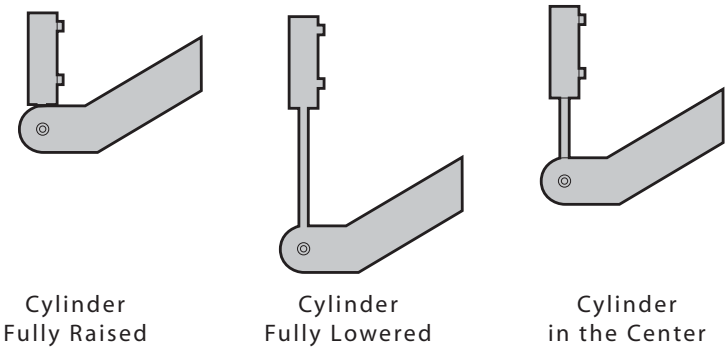


Figure 117: Center the Tow Point Cylinders

3. Using the manual thickness adjustment cranks or hand cranks on the paver, null the screed and set the proper angle of attack (Figure 118). Make sure both cranks are set the same.

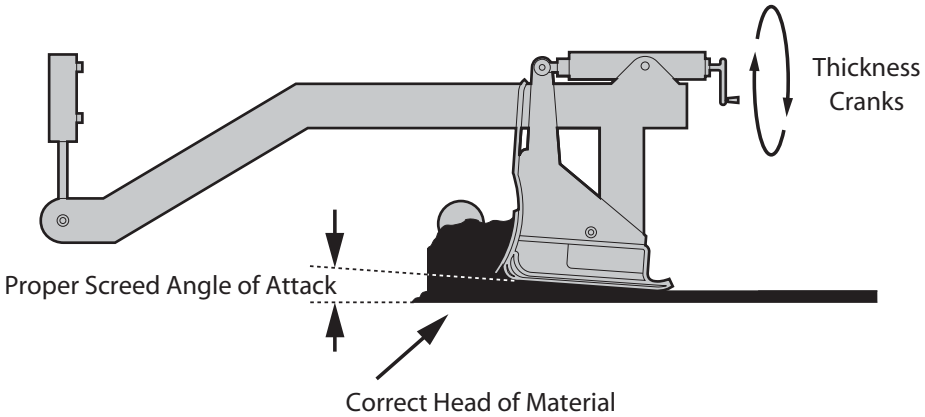


Figure 118: Manually Adjust Thickness of Mat

4. Next, turn on the auger feeder controls to place the asphalt in front of the screed.

Sonic Tracker Setup

The following steps describe installing and positioning the Sonic Tracker on the Paver. For more information see “Sonic Tracker Placement” on page 45

1. Connect the coil cord to the Tracker (ST-3 or Sonic Tracker II).
2. Bolt the Tracker to the bracket, and visually check to get the Sonic Tracker plumb.
3. Make one wrap of the coil cord around the L-Bar (Sonic Tracker II only). This acts as a strain relief for the connector on the Tracker.
4. Always, snap the temperature bail into place
5. Place the Sonic Tracker over the reference: raise or lower the Tracker bracket to position it at a proper height above the grade reference.
6. Press the **Survey** button on the Control Box to lock trackers On-Grade.
7. Press and hold the **Set** button while dialing in mat depth.
8. Put the Control Box in Auto and begin paving.

SAS Setup

Once the SAS has been installed, the Slope Sensor automatically configures for SAS when powered on. The box checks to see how many trackers are connected and average over that amount. Getting the Control Box ready to pave is the same as with one tracker.

1. Connect each tracker as described in “Sonic Tracker Setup” on page 68, but using the SAS coil cord.
2. Place the SAS trackers over the reference: raise or lower the trackers bracket to position it at a proper height above the grade reference.
3. Press and hold the Set button while dialing in mat depth.
4. Put the Control Box in Auto and begin paving.

It is not necessary to start paving in manual as is traditionally done when using a mechanical ski. If the setup procedures are followed correctly, paving with the SAS can and should start in Automatic.

The SAS system is designed to discontinue operating when one of the Trackers fails. When a failure occurs, the color of the SAS icon on the Control Box’s Control screen changes from green or yellow to red (Figure 119 on page 68). The number (1, 2, 3, and 4) represents each connected Tracker. If a Tracker is disconnected, the corresponding icon disappears from the screen.

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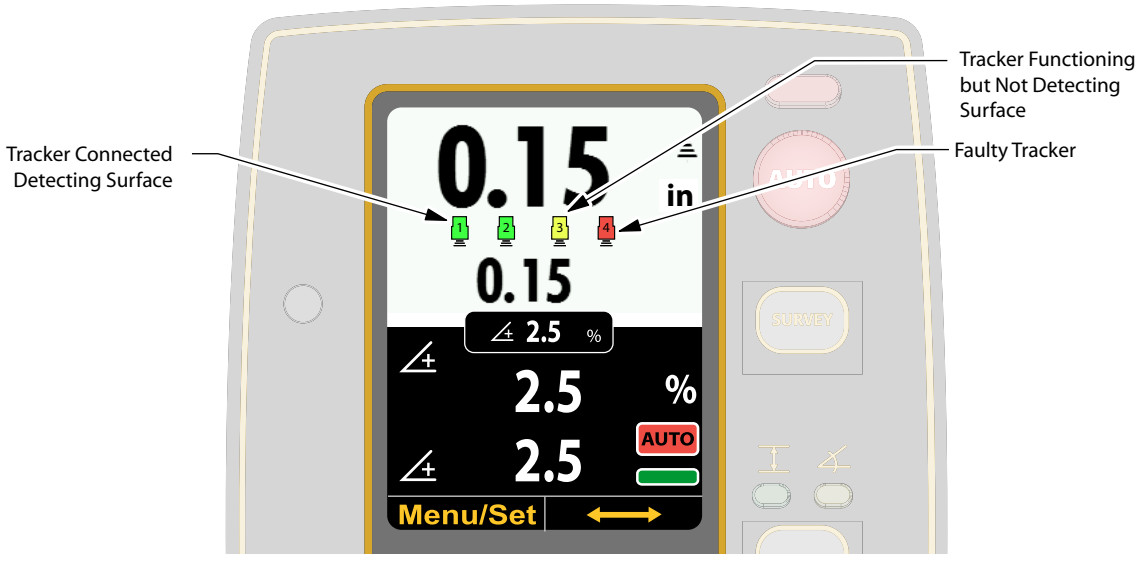

Figure 119: SAS Icons

To reset the Slope Sensor once a new tracker has been installed, or if the tracker has been removed and only three trackers are used, turn the power off then on. The Slope Sensor reconfigures to the number of trackers. Changing the number of trackers may change the average distance. Press **Survey** to lock SAS On-Grade.

Once one of the Trackers has been eliminated from the averaging, the balance point of the beam changes. If the faulty Tracker is not replaced, the beam must be repositioned to adjust for the new balance point. It is strongly recommended, if the first or last Tracker fails, to replace it with one of the Trackers from the middle of the beam. This insures that the balance point is not outside of the 1/3 to 2/3 rule.

Control Box Setup for Elevation Control

Once the Sonic Tracker has been positioned over the reference, the Control Box can now Survey to On-Grade.

1. With the power on, press the **Survey** button(Figure 120).

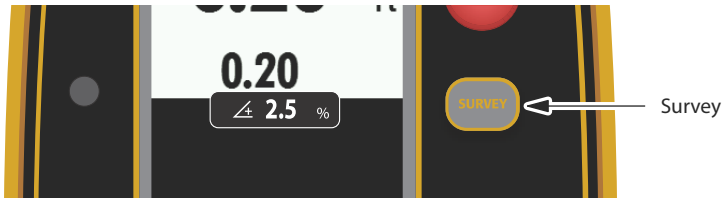

Figure 120: Setting the Tracker On-grade

2. To make the display read the same value as the depth of mat to be laid, press and hold the **Menu/Set** button while turning the Grade Adjustment Knob to change the display to the height of the blocks under the screed (Figure 121).
3. Release **Menu/Set** to save the value.

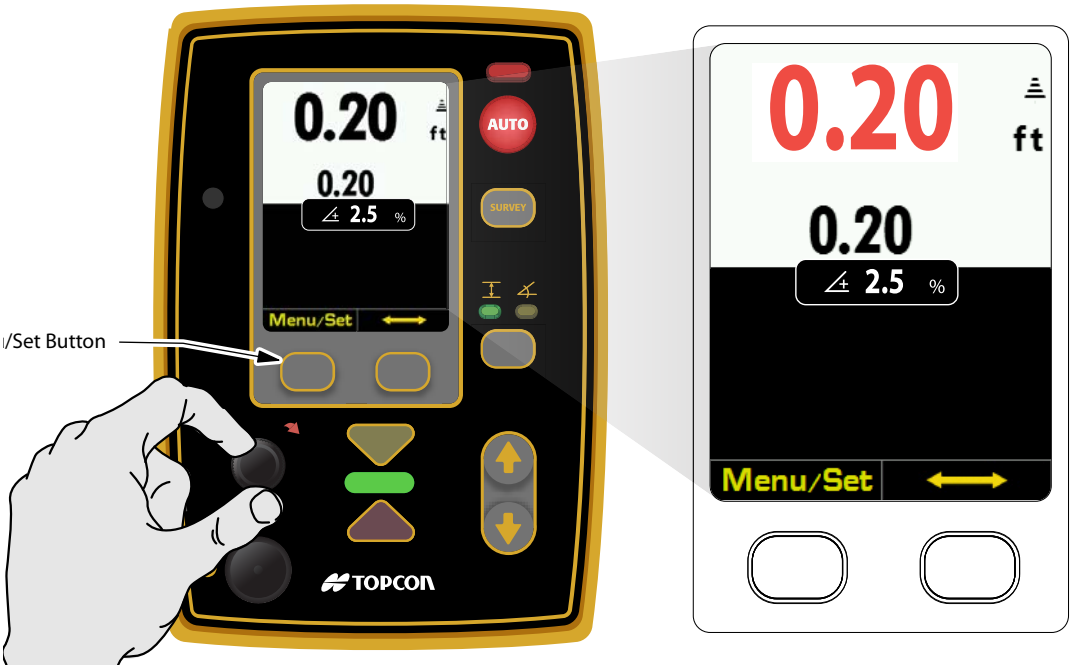

Figure 121: Saving Elevation Value

Using **Menu/Set** does not change the existing mat thickness, it only changes the reference number viewed on the display.

4. Press the **Auto** button to put the Control Box into Automatic mode (Figure 122). The Auto LED lights up.

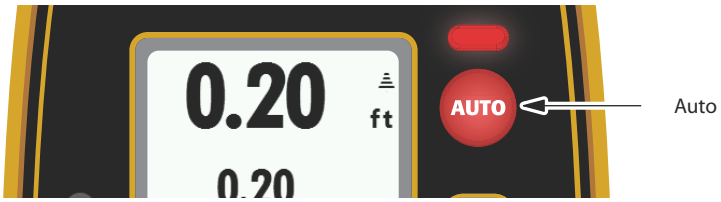

Figure 122: Selecting Automatic Mode

5. Begin paving.

After you begin paving, check the mat depth to ensure the desired thickness is being laid (Figure 123). The blocks initially placed under the screed may cause the mat to be too thick or too thin. Check the mat several times to get an average before making any corrections.

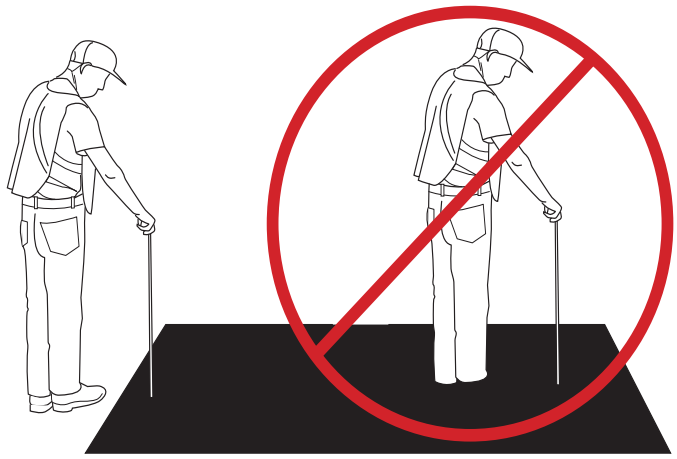

Figure 123: Checking Pad Thickness

For example, if a 2.50 inch mat is required, but a 3.0 inch mat is being laid, then an adjustment is necessary. You must first get the box to display the same number as the mat depth.

Actual mat thickness adjustment value may vary depending on paving conditions.

To change the mat depth being laid:

1. Press the Auto button to put the Control Box and Paver into manual mode. The Auto LED goes dark.

2. Press and hold the **Menu/Set** button while turning the Grade Adjustment Knob to read 3.00 inches (Figure 124). Release **the Menu/Set** button to apply the setting.

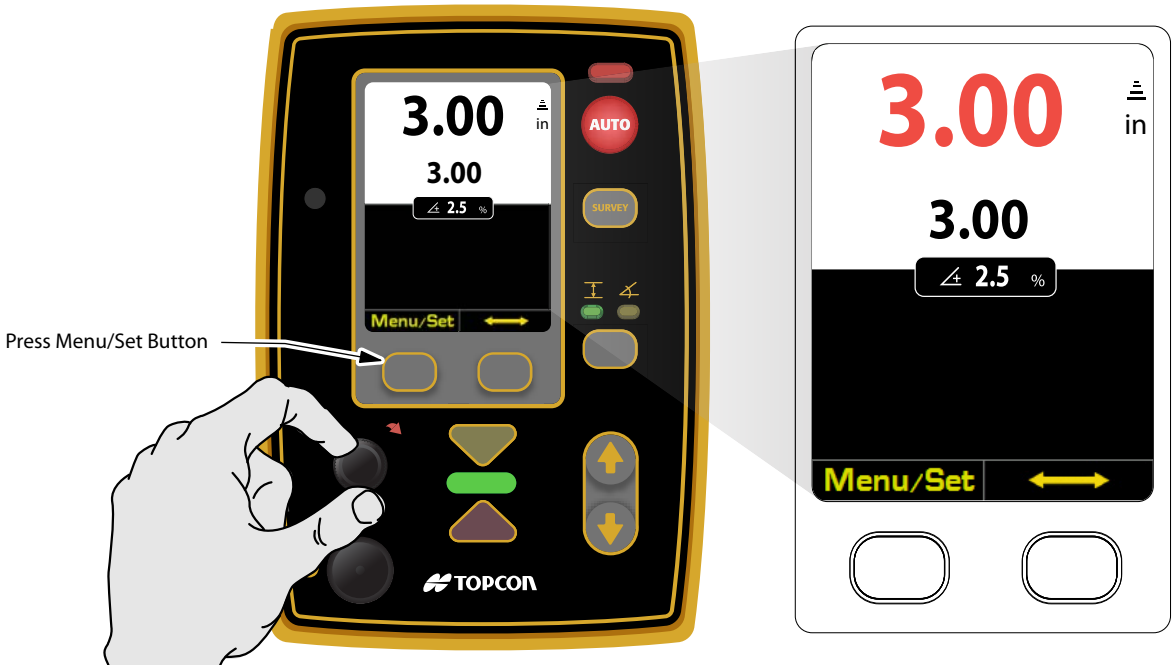

Figure 124: Adjusting Grade

3. Press **Auto** to switch the Control Box to Automatic mode.
4. With the paver moving and the Control Boxes in Automatic, slowly dial the display from 3 inches down to 2.5 inches (Figure 125).

   How fast you turn the knob depends on how smooth you want the transition to take place. Highways require gradual changes, parking lots require quick changes. The display should now read the depth of the mat being laid.

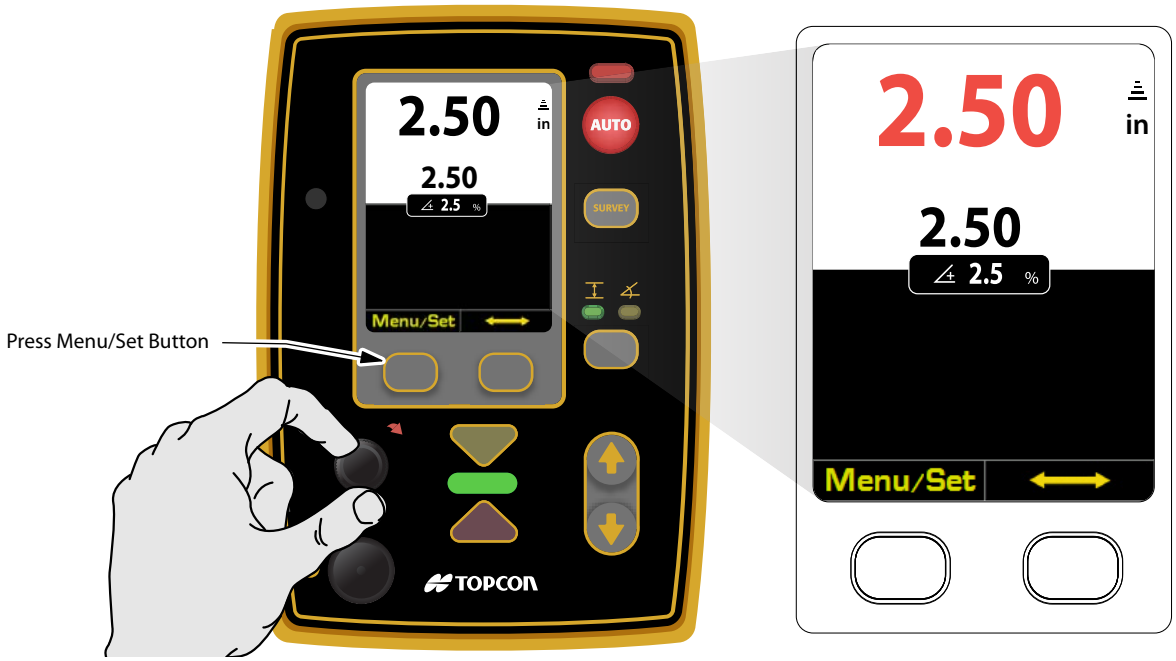

Figure 125: Slowly Adjusting Grade

Control Box Setup for Slope Control

The Slope Sensor should already be mounted on the transverse beam of the paver. The sensor can talk to both Slope Sensores, but only one at a time. The sensor communicates to the Control Box through the cable.

To pave using slope control you must first calibrate the Slope Sensor, to the screed.

1. Find a smooth area where the screed can rest evenly across its entire surface. Using a laser, a Smart Level, or a slope board, that itself has been calibrated, check the slope and direction of fall of the ground (Figure 126).

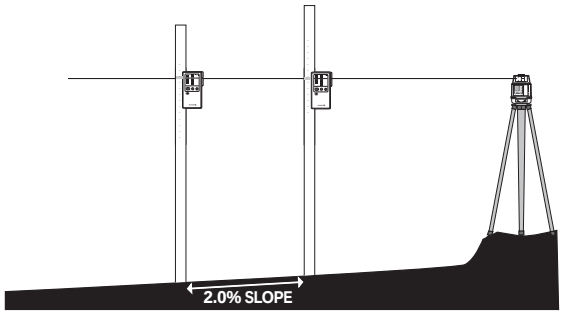

Figure 126: Checking Slope

2. Place the screed on the ground and null it out.
3. With the Control Box on, press the **Elevation/Slope** button, until the yellow LED below to the slope symbol illuminates (Figure 127).

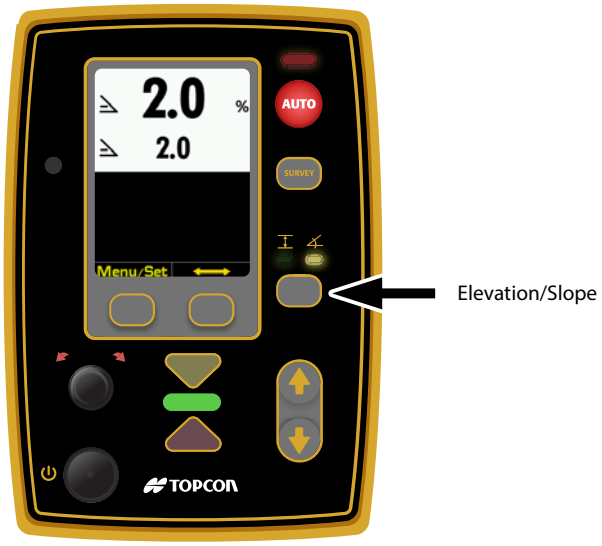

Figure 127: Setting the Control Box to Slope Mode

4. To display the actual slope percentage, press **Survey**.
   - If the On-Grade bar is illuminated, and the screen displays a slope value that is identical to the laser or Smart Level, press the **Auto** button to put the Control Box into Automatic control, and begin paving.
   - If the slope displayed in the box does not match the surface, then you must calibrate the Slope Sensor.

You must turn Off Slope Calibration Block in the Performance Menu before calibrating the Slope Sensor.

5. From the **Performance Menu** choose **Slope Cal. Block**, and then select **Off**.

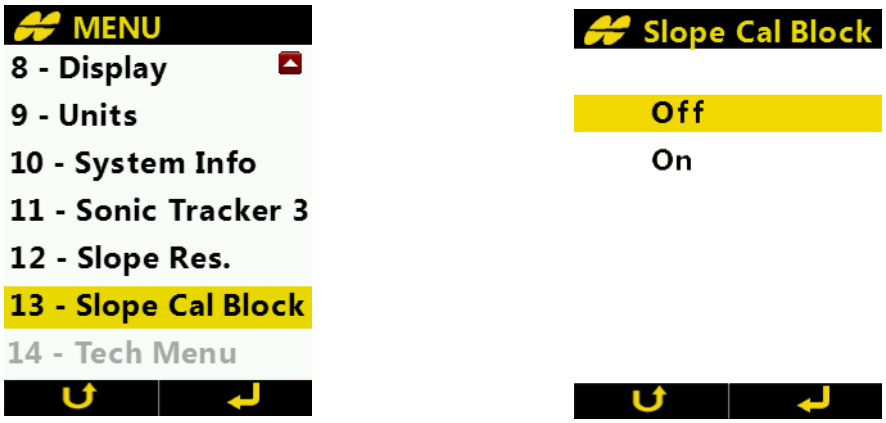

Figure 128: Slope Calibration Block

6. Return to the Control Screen (Figure 129).
7. Press and hold the **Menu/Set** button while turning the Grade Adjustment Knob to change the display to match the slope of surface (Figure 129). Release **Menu/Set** to save the value.

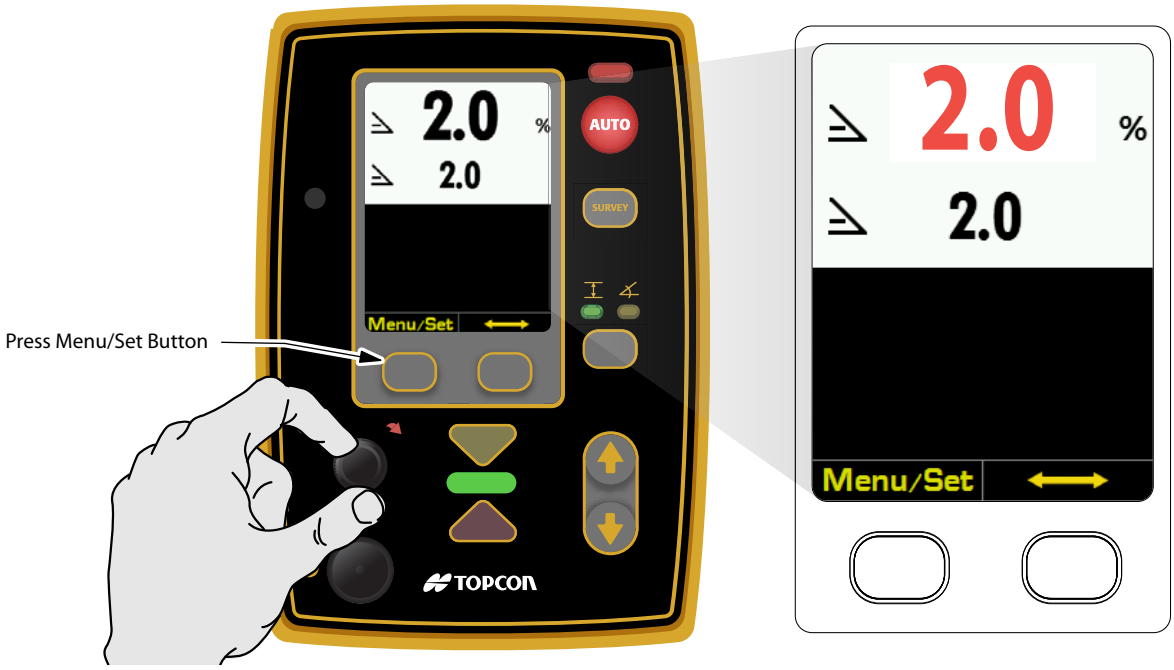

Figure 129: Setting the Slope Value

Using Menu/Set to change the slope value does not change the slope, it only changes the slope value viewed on the display.

8. Enter the **Performance Menu** again, and choose **Slope Cal. Block**. Set **Slope Cal. Block** back to **On**.

9. Press the **Auto** button to put the Control Box into Automatic mode (Figure 122). The Auto LED lights up.

Figure 130: Selecting Automatic Mode

10. Once the Slope Sensor is calibrated and you are ready to begin paving, you may find the existing surface does not have the same slope as the finish design. In order to produce a smooth transition, begin paving at the existing slope and slowly turn the Grade Adjustment Knob to change the cross slope to the correct percentage.

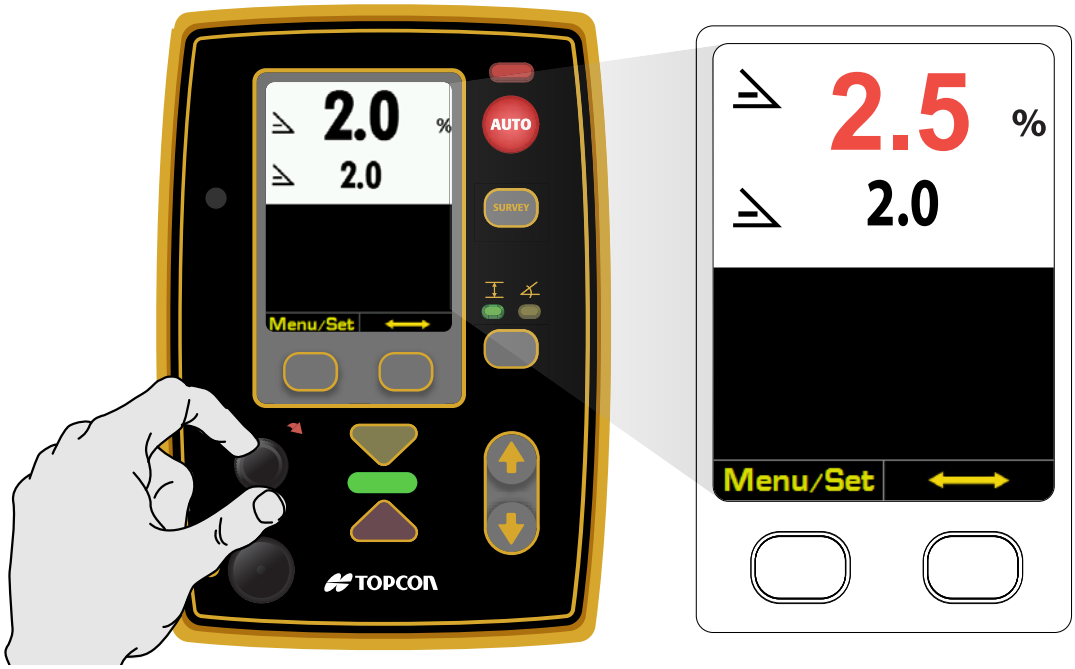

Figure 131: Producing a Smooth Slope Transition

If a smooth transition is not required, then dial in the desired slope and begin paving.

The type of controls you decide to use (elevation sensors, or Slope Sensor and elevation sensor) for paving depends on the result required for the finished product. Some projects require;

- smoothness and improved rideability
- consistent mat thickness
- the new asphalt to match curb and gutter
- the new asphalt to match existing grades

The following sections describe a few examples of paving projects using your Topcon P-32+ or P-32 System.

If you are using an ST-3 for elevation control make sure the correct setting is selected in the Control Box Performance Menu. See “Sonic Tracker 3 (P-32+ System only)” on page 39.

Paving City Streets with Sonics

When paving city streets, the general requirement is to lay a mat that is so many inches above the base at the centerline and to match curb and gutter (Figure 132). For this application, sonic control is used on both sides.

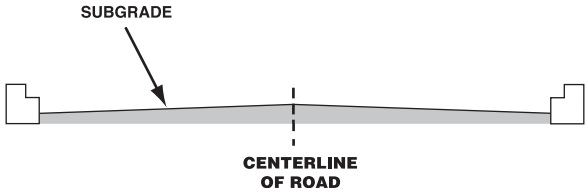

Figure 132: Paving to Center Line and to Match Curb

1. Before paving, make sure the machine is properly setup, cross slope is calibrated, and trackers are set in the correct position. See Chapter 5 and Chapter 6 for details.
2. Position right tracker over lip of gutter and left Tracker past the centerline on the base material (Figure 133).

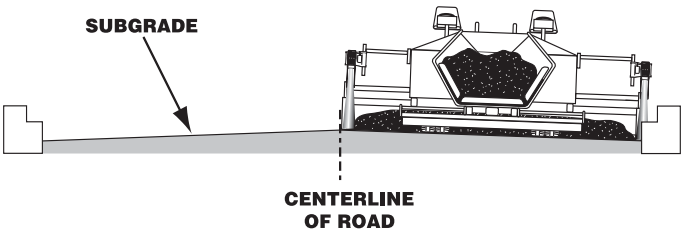

Figure 133: Positioning Tracker Over Gutter

3. Turn on the Control Boxes, then Survey and Set the displays to read the depth of asphalt to be laid (Figure 134).

Figure 134: Control Box Displays – Depth of Asphalt

4. Put both Control Boxes in automatic mode and begin paving. Check the depth of mat at centerline and verify joint matches at lip of gutter. After compaction, make the necessary adjustments at the Control Box.

If the road width varies, it is easier to keep the Tracker over the gutter if the Tracker is mounted to the extension on the screed.

5. To pave the other side of the road, position the left tracker over the lip of the gutter and place the right tracker over the new mat (Figure 135).

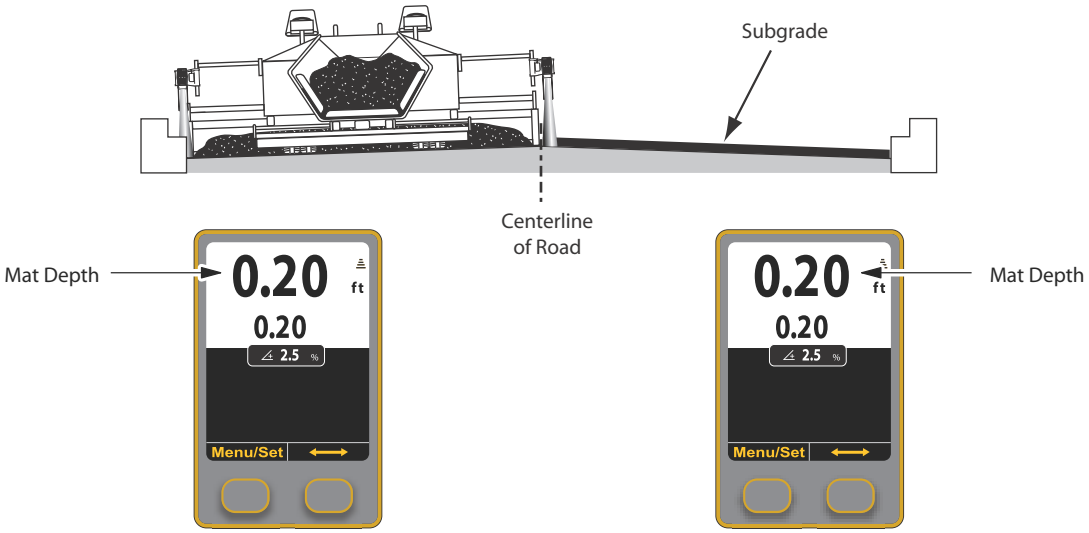

Figure 135: Paving Other Side of Road

6. Survey both Control Boxes On-Grade and Set the displays to read the depth of asphalt to be laid. Put the Control Boxes in automatic mode and begin paving. Check to make sure joints match after compaction.

Paving City Streets with Cross Slope

Another option is to pave the street using cross slope and sonic control. The tracker is positioned over the lip of gutter on one side and cross slope is dialed in for the crown on the other. This method may have to be modified due to the fact that in many cases, the curbs may be poured at different elevations on either side of the street. Even though the curb was poured out of tolerance, it may have passed inspection and the asphalt needs to match the curb and gutter. If the curbs are at different elevations, it is impossible to pave a typical design slope on both sides of the street.

A cross section design of a 36 feet wide street with a 2.0% slope produces a 36 feet rise at centerline (Figure 136).

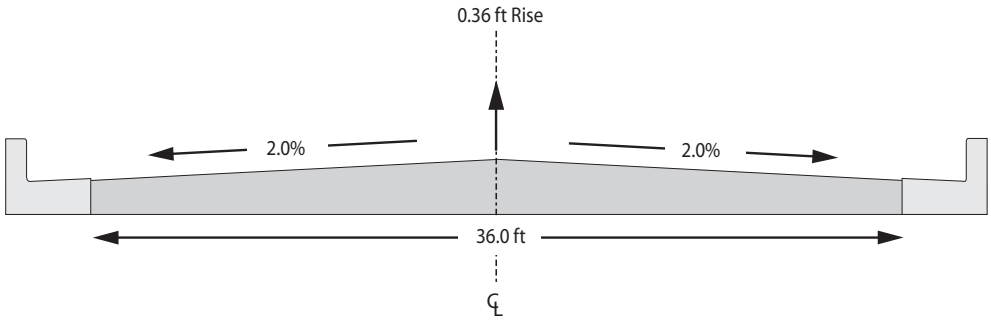

Figure 136: Paving with Cross Slope

If the curbs are at different elevations, a 36 feet rise at centerline produces incorrect slopes (Figure 137).

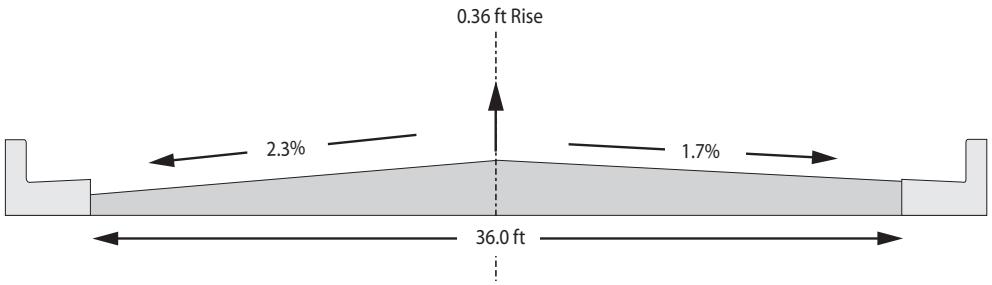

Figure 137: Curbs with Different Elevations

When using your Topcon P-32+ or P-32 System to pave a true 2.0% slope, the crown of the street will not be at the centerline (Figure 138).

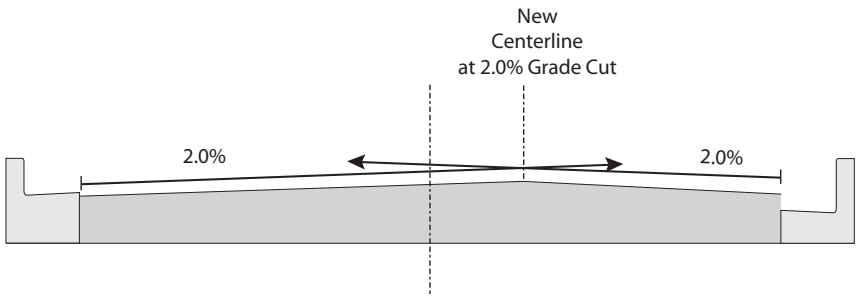

Figure 138: Curb with Same Slope

To pave from uneven curbs using slope control, choose the side of the road with the highest curb and position the tracker over the curb. Set the other side for the desired cross slope and begin paving (Figure 139).

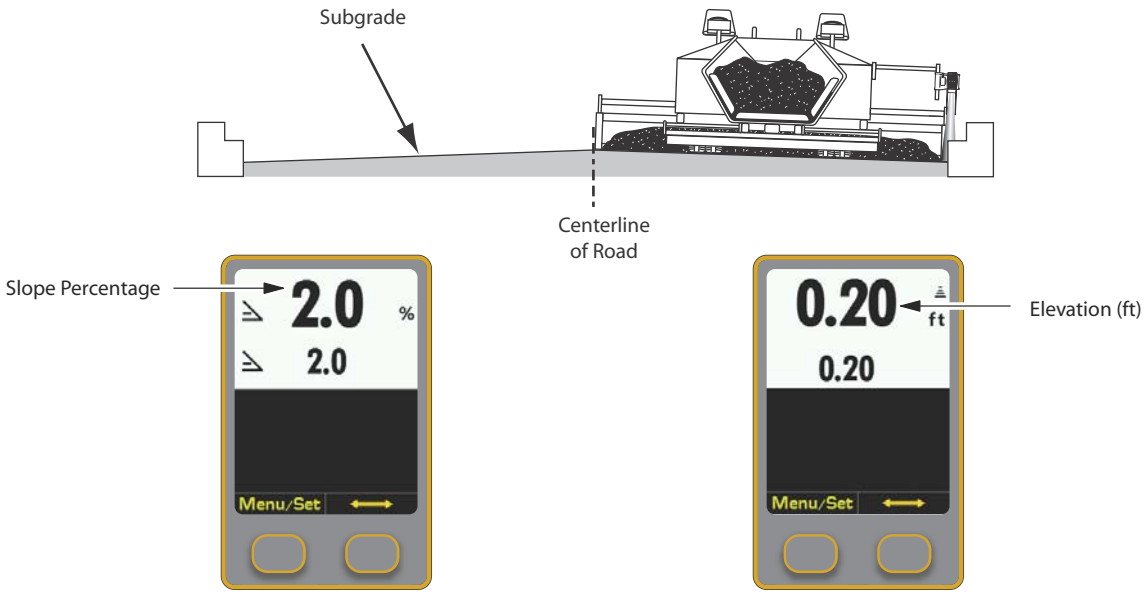

Figure 139: Paving Uneven Curbs with Slope Control

To keep the centerline in the middle of the road, you must set up the second pass using Sonic Control on each side of the paver. The left tracker matches the lip of the curb and the right side tracker follows the new mat (Figure 140). The cross is not consistent on this side of the roadway, but the joints match. Prevent moving the Sonic Tracker away from the crown, as that changes the elevation.

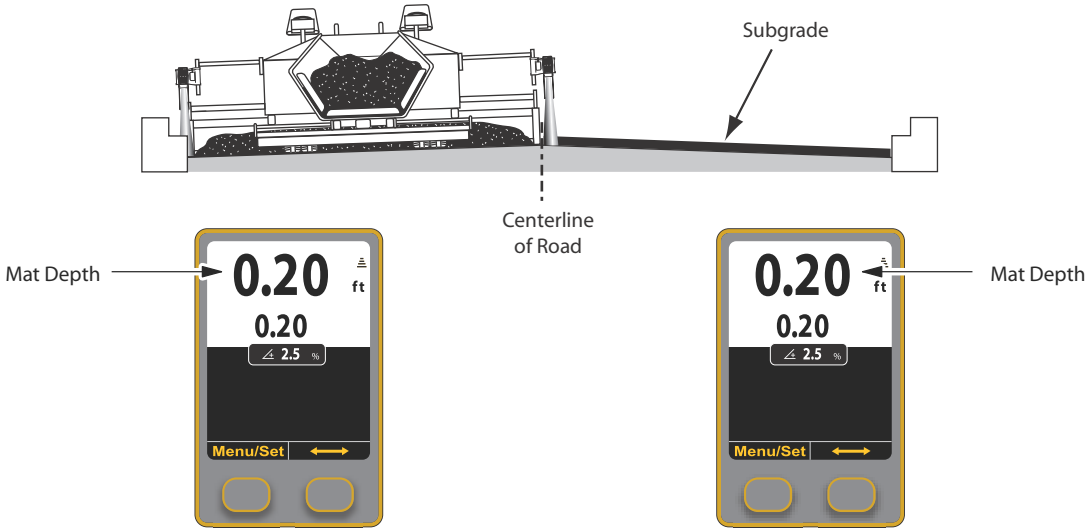

Figure 140: Second Pass when Paving Uneven Curbs

The curb elevations can be easily spot checked using a fast leveling RL-HB rotating laser. Set the laser at the lip of one curb, then use the detector and a folding rule to take a reading on the other curb (Figure 141). Spot check every 25-50 feet by just moving the laser.

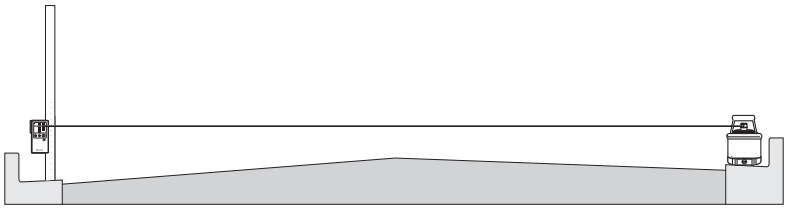

Figure 141: Checking Curb Elevations

Paving Streets Through Intersections

As you pave city streets, you will come upon intersections where the curb stops. There are a couple of methods for controlling grade through the intersection.

Method 1 for Paving Intersections

For this method, the base of the intersecting road is used as the reference.

1. On both Control Boxes, press the **Elevation/Slope** button to set them to Elevation control.
2. On both Control Boxes, press **Auto** on set both Control Boxes to Automatic.
3. Pave to the intersection (Figure 142).

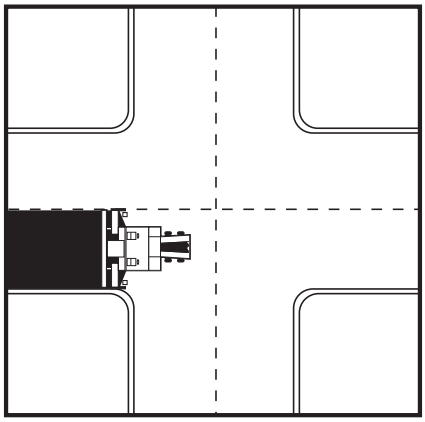

Figure 142: Paving Through Intersections

4. Just before the right tracker reaches the end of the curb, press **Auto** on the right side Control Box to switch to manual mode (Figure 143).

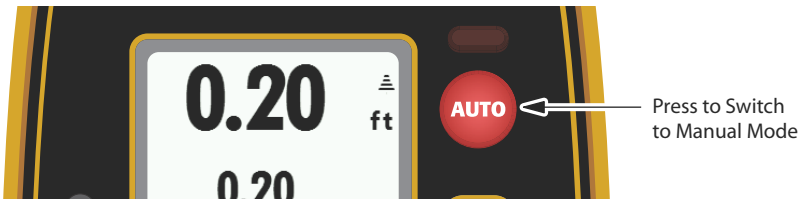

Figure 143: Control Box in Manual Mode

5. Without stopping, continue paving until the right tracker is on the base material of the intersecting road.

6. On the right side Control Box, press **Survey** to take an elevation reading of the new reference (Figure 144), and then press **Auto** to switch to Automatic mode.

Figure 144: Survey to On-grade and Return to Automatic Control

7. Pave through the intersection, and just before the right side Tracker reaches the curb on the other side of the intersection (Figure 145), press **Auto** to switch to Manual mode.

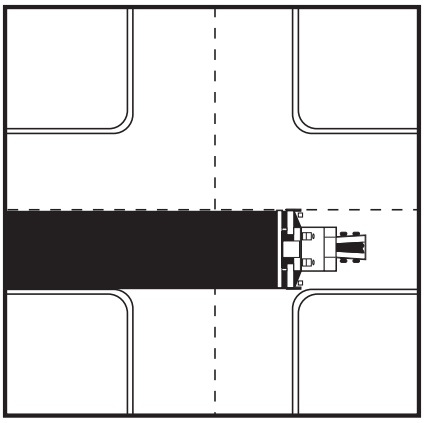

Figure 145: Paving Through Intersection

8. Without stopping, continue paving until the tracker is back on the lip of the curb. **Survey** to On-Grade (Figure 146), and press **Auto** to switch to Automatic control.

Figure 146: Survey to On-Grade and Return to Automatic Control

You may find after surveying that for the tracker on the curb the number has changed slightly from the curb on the other side of the intersection. This is due to the different depth of the base below the lip of curbs. While paving, slowly dial the display back to the previous number.

Method 2 for Paving Intersections

1. Sometimes, the base of the intersecting road is too rough to use as a reference. An alternative is to use a simple piece of stringline.
2. Take a section of 1/8” diameter string and nail or secure it to the curb.
3. Pull the string tight through the intersection and nail or secure it to the other curb (Figure 147).

If the intersecting road has a crown, hike the stringline up in the middle of the road to place the string at the proper height. A hub or a stake with a piece of wire to hold the stringline works fine.

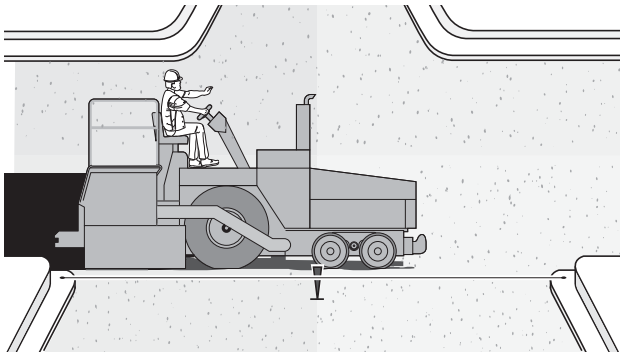

Figure 147: Paving Through Intersection Using Hub

This constant reference gives you complete control through the intersection and ensures that you tie in perfectly to both curbs.

Paving Intersections with Cross Slope

When paving with slope, intersections do not require any adjustments if the “mainline” cross slope does not change. If the slope does change, then use a combination of slope and elevation (Figure 148).

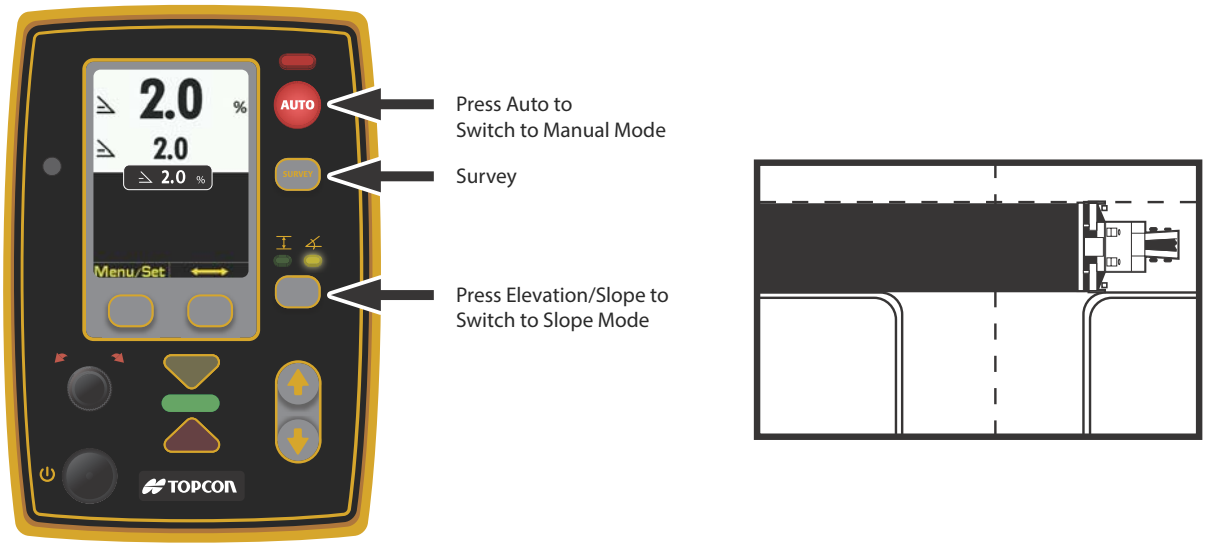

Figure 148: Paving Intersections with Cross Slopesv

1. Just before the slope of the intersection begins to change, press **Auto** to switch the slope side of Paver in Manual mode (Figure 149).

Figure 149: Switching to Elevation Control and Surveying On-grade

2. Press the **Elevation/Slope** button to switch from slope to elevation control on the Control Box, and **Survey** to On-Grade (Figure 150).

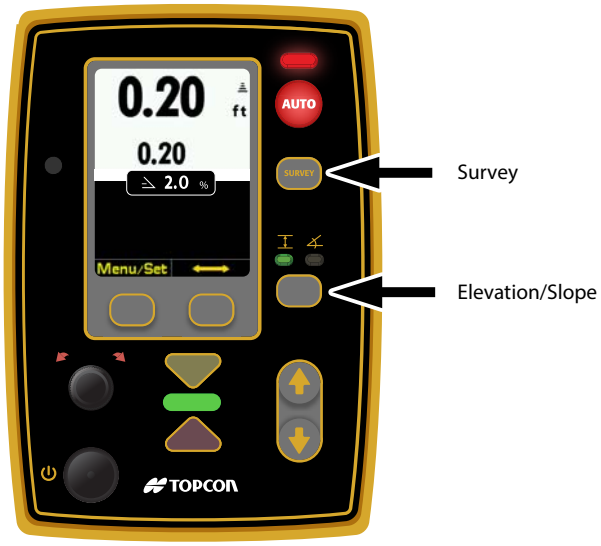

Figure 150: Surveying to On-grade

3. Press **Auto,** and pave through the intersection with the Control Box in Automatic mode.
4. Upon reaching the end of the intersection (Figure 151), press **Auto** to switch to Manual mode, press **Elevation/Slope** to switch to slope control, and press **Survey**.

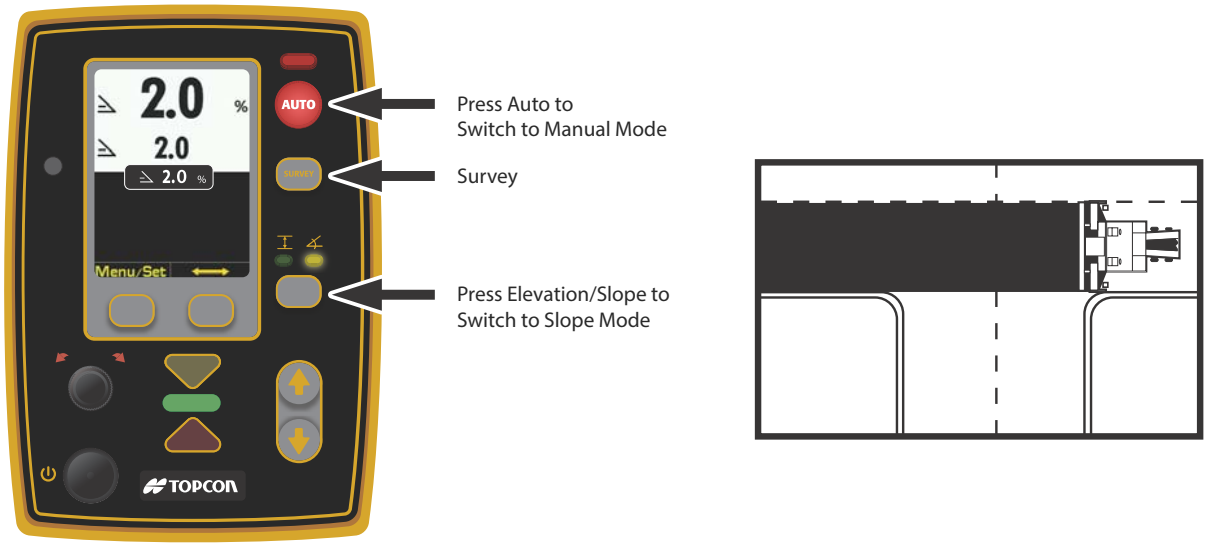

Figure 151: Paving Through Intersection

5. Press **Auto**. If the slope is not as desired, use the rotary knob to gradually change the slope percentage to the desired slope.

After surveying the slope, because of the switch from slope to elevation control, you may find that the slope of the mat you just laid down (as displayed on the Control Box) does not match your desired slope. To get back to the correct slope, continue paving in automatic and slowly dial the display to the desired slope. Failing to press **Survey** when changing back to slope control could result in a bump in the mat.

Sonic stringline provides an inexpensive, easy to set up, continuous reference that takes the best advantage of the non-contacting feature of the Sonic Tracker. Stringline takes a few minutes to setup, and becomes a constant grade reference. The stringline also becomes a visual reference for the job, allowing any mistakes in a hub elevation to be quickly spotted by sighting down the string.

Sonic stringline is both a reference and an averaging solution.

- As a reference, surface and elevated stringline provides consistent results for level and sloped surfaces.
- As an averaging solution, surface stringline takes the place of averaging skis.

The sonic stringline setup consists of readily available materials and up to 500 feet of nylon stringline. Topcon's Sonic Tracker works with many sizes and types of stringline, for best results use an 1/8 inch diameter nylon stringline.

Using steel wire or a plastic coated stringline with a smooth surface can provide erroneous results.

For a review of how the Sonic Tracker works, see "Sonic Control" on page 14. If the Sonic Tracker tracks the ground but not a 1/8 inch diameter stringline, clean or replace the transducer. See Chapter 7 for this procedure.

Setting Surface Stringline

The ST-3 is not capable of using a surface stringline. Only use a surface stringline when using a Sonic Tracker II.

A surface stringline provides a low-impact reference and averaging solution for steering and grade control. Because it rests close to the surface, trucks and other traffic can drive over the stringline without causing control problems and reference damage.

As a grade reference, pavers use the Sonic Tracker to track the stringline, producing a consistent and constant cut. When sighting down the stringline, problem areas can be spotted, and marked or fixed, before paving begins.

Surface stringline replaces a contacting averaging ski when a reference is unavailable or impractical. Averaging skis average out the irregularities of the surface being cut, but can be impractical, bulky, complex, and fragile. Surface stringline is simple, more practical, and easier to maintain than an averaging ski. When stretched over the ground, surface stringline levels the high places and bridges the low (Figure 152), creating a natural average over a distance as long as 500 feet.

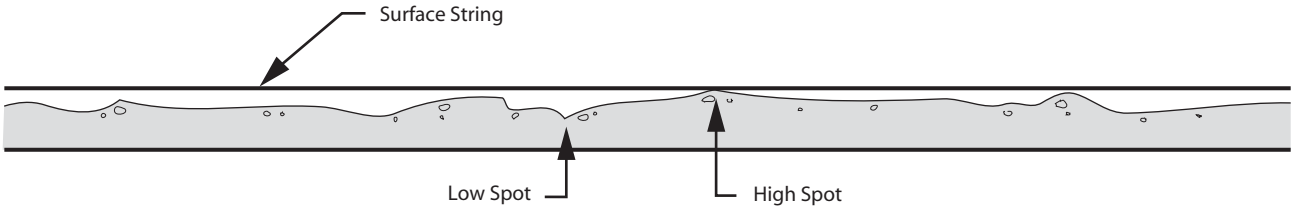

Figure 152: Surface String Averaging

A surface stringline is a verifiable reference for any job, replacing cumbersome averaging skis. In coordination with the Sonic Tracker, stringline acts as 5 to 500 foot long, virtual, and more accurate, averaging ski.

Sometimes, the surface to be paved contains pot holes or surfaces too broken to use as a joint match reference Setting elevated stringline would be too time consuming, especially for small, divided projects. In these applications, surface stringline provides a simple, easy alternative.

Position the tracker 14 to 18 inches above the stringline (Figure 153).

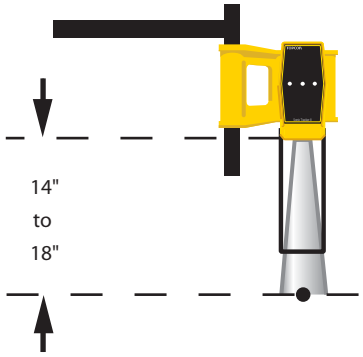

Figure 153: Position of Tracker in Correlation to Stringline

It is important to use a stringline with a diameter at least 1/8” thick. The Slope Sensor can detect a smaller diameter stringline, but when stretched on the surface to be paved the surface below the stringline will be within the working window, therefore you want to make sure you have a strong return signal.

To setup surface stringline in two simple steps:

1. Drive a concrete nail into the existing surface to be cut (Figure 154) and tie the stringline to the concrete nail.

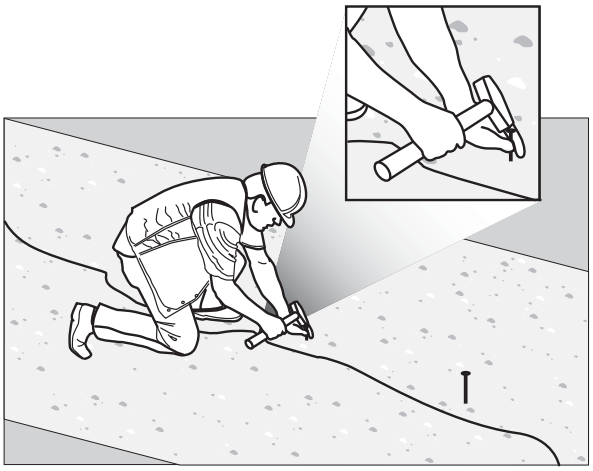

Figure 154: Setup Concrete Nails

2. Roll out the stringline to the desired length. Pull tight and secure to another nail at the opposite end. The tightened stringline rests on top of the existing surface (Figure 155).

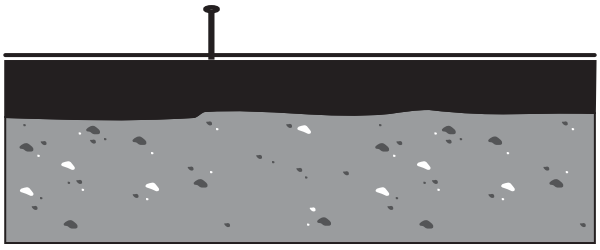

Figure 155: Stringline Reference

- When the Slope Sensor sends out a sound wave, the first thing the tracker sees is the reference stringline.
- Since the stringline is pulled tight, any small irregularities in the existing surface are spanned (Figure 156).

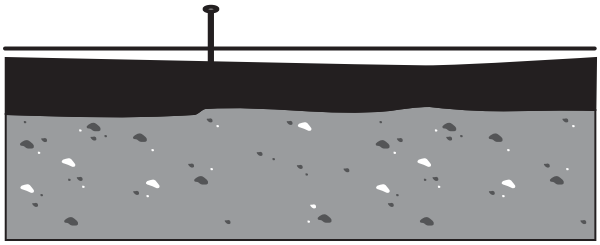

Figure 156: Stringline Spans Surface Irregularities

As a verifiable grade reference, potential problems can be pointed out to the inspector before paving.

Setting Elevated Stringline

Elevated stringline is positioned 1–2 feet above the finished grade using referencing hubs or lath placed by the surveyor (Figure 157).

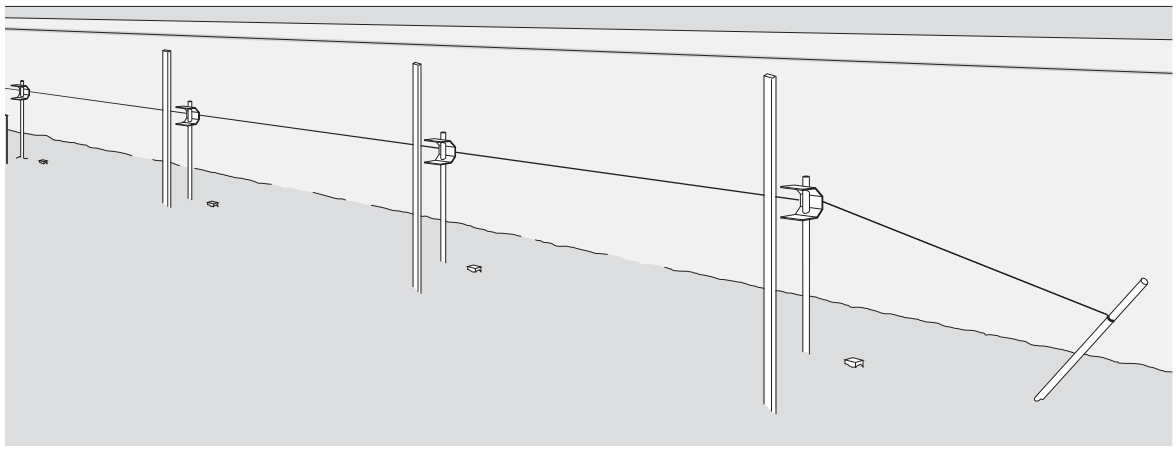

Figure 157: Elevated Stringline

Once positioned, the Sonic Tracker tracks the stringline, providing a verifiable slope and cut reference.l

The ST-3 indicates the location of the stringline by using left/right arrows and On-Grade (centered) LEDs. See “Stringline Mode” on page 54 for more information.

The ST-3 LEDs help guide the operator to manually shift the screed in/out. Accurate setup of the stringline is crucial for proper operation of the ST-3.

Do not disturb the hubs.

Your local Topcon dealer carries the following supplies for setting elevated stringline:

- Sonic stringline, 1000’ roll (p/n 7020-0101)
- Sonic grade clips, box of 100 (p/n 7020-0121)
- Cut/fill offset tape, feet/tenths (p/n 7000-1026)
- Cut/fill offset tape, metric (p/n 7000-1027)

Although Topcon’s Sonic Tracker works with many sizes and types of stringline, for best results use an 1/8 inch diameter nylon stringline. Using steel wire or a plastic coated stringline with a smooth surface can cause erroneous results.

1. Place the sonic grade clips on stakes and drive the stakes approximately 6 to 8 inches away from, but in line with, the hubs—Do Not disturb the hubs (Figure 158).

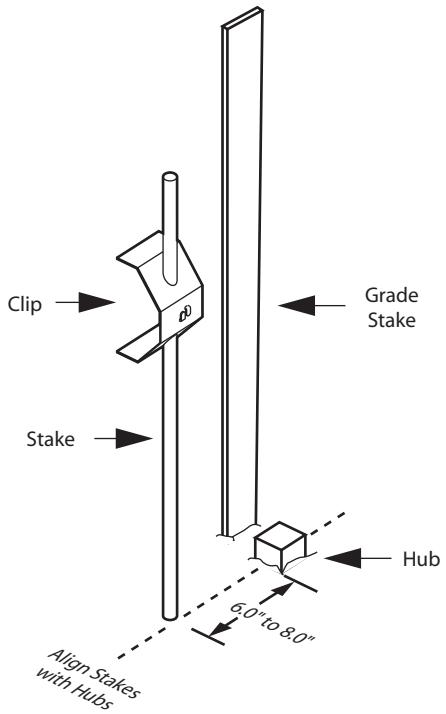

Figure 158: Place Clips and Position Stakes

2. Using an anchor pin at each end, roll out the sonic stringline the length of the working area and pull the stringline tight.
3. After the stringline has been pulled tight, place it into the “fingers” of each Sonic Grade Clip (Figure 159).

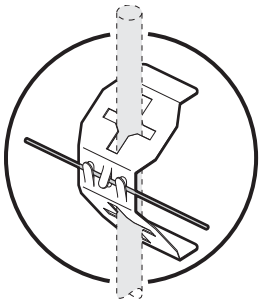

Figure 159: Place Stringline in Clip

4. Decide what the sonic stringline hike-up (the distance from finished grade to the sonic stringline) should be; in this example, two feet.

Making a Cut/Fill Lath

Once you have the stringline setup, fine-tune the height of the stringline above the grade. To do this, make a cut/fill lath using a lath and a Topcon cut/fill decal.

1. Assemble the required number of laths for the job.
2. Measure from the bottom of the lath to the desired height above grade, and make a mark at that point. Place the cut/fill decal on the lath with “0” at the marked point (Figure 160).

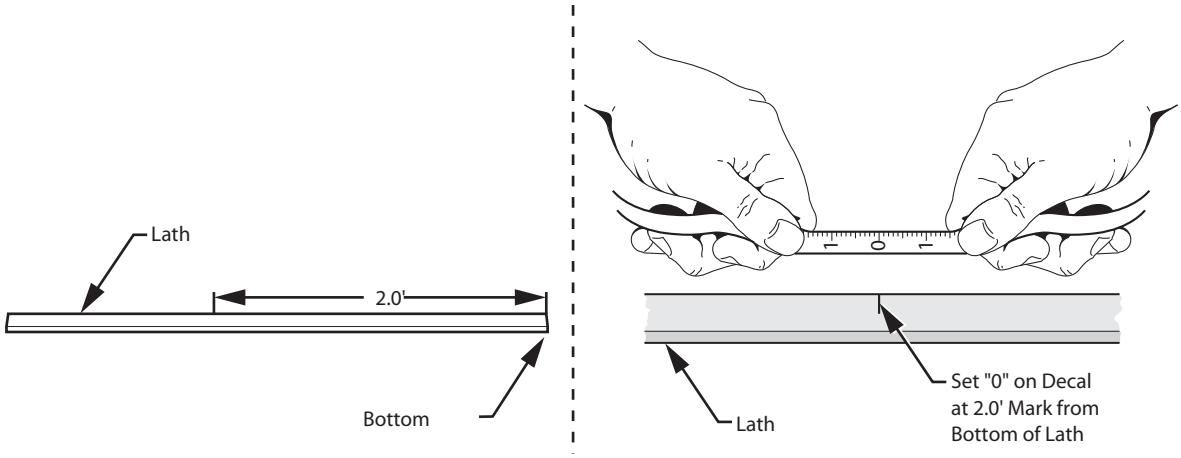

Figure 160: Measure Height Above Grade and Place Cut/Fill Decal

The ST-3 is capable of indicating the center of the sensor to the stringline. Accurate placement of the stringline helps to operate the screed shifting in/out by using the ST-3 feature.

3. Set the cut/fill lath on the hub and read the cut or fill from the grade stake next to the hub. Adjust the clip up or down until the stringline crosses the cut/fill lath at that point (Figure 161).

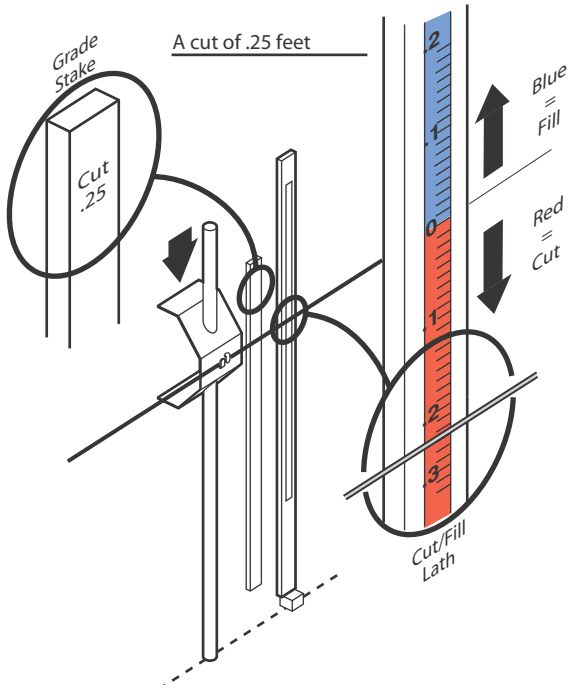

Figure 161: Adjust Clip and Stringline to Desired Cut/Fill

The stringline is now set to 2 feet above finished grade.

4. Repeat step 3 on page 88 at each station before starting to cut (Figure 162).

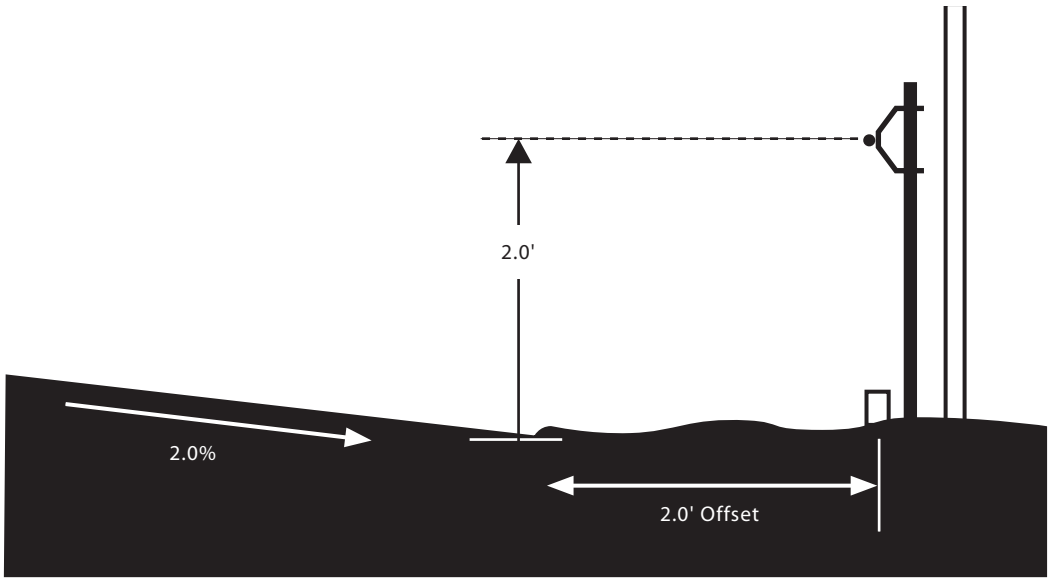

Figure 162: Stringline Set at Desired Elevation

Attaching Stringline to the Grade Stake

Some jobs may require the stringline to be secured directly to the grade stake rather than attached to the clip.

1. Mark the lath with the desired “hike-up” above grade (Figure 163).

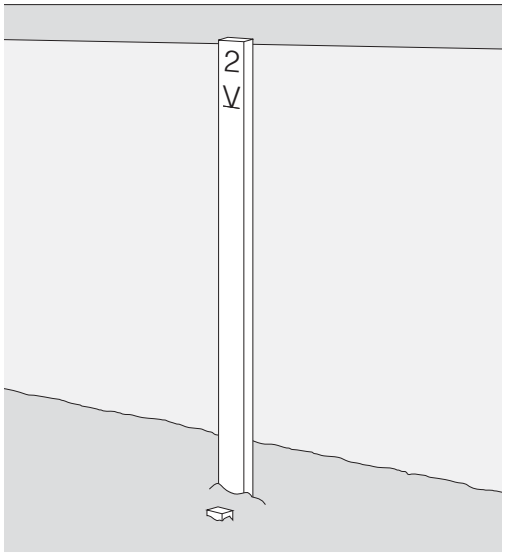

Figure 163: Mark Lath with Hike-up Height

2. Secure an anchor pin at each end of the stringline and pull the stringline tight.

3. At each station, staple or Ty-wrap the stringline directly to the witness lath at the desired “hike-up” (Figure 164).

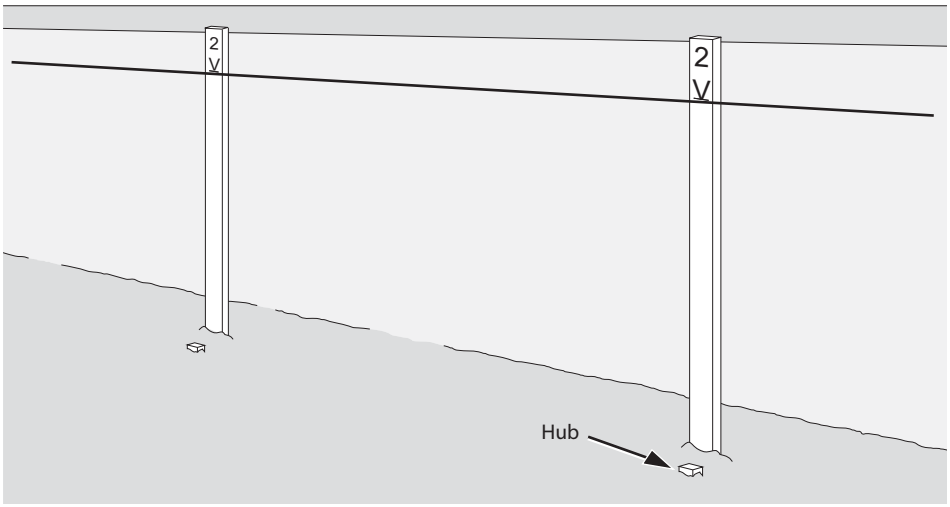

Figure 164: Stringline Attached to Lath

4. Due to the height of some stakes, raise the Tracker or cut off the tops of the stakes.

Setting Projected Slope Stringline

Jobs with slope transitions or super-elevations have the stringline set to the “projected slope.” As the profiler cuts, the Sonic Tracker and mill follow the slope of the job, preventing elevation errors at the edge of the road as the slope changes.

To set the stringline to the projected slope,

1. Set up the string at the desired elevation as shown in “Setting Elevated Stringline” on page 86.
2. Raise or lower the stringline to compensate for the percentage of slope and the distance from the edge of the road to the stringline:

   Rise = Run X Slope Percentage

   - If the road rises away from the stringline, lower the stringline (Figure 165).

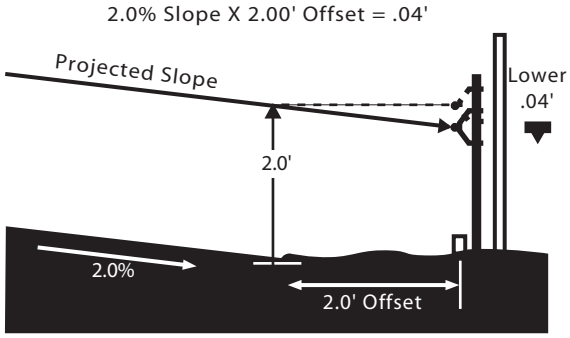

Figure 165: Lower Stringline: 2% Cross Slope with 2 Foot Offset

- If the road slopes down from the stringline, raise the stringline (Figure 166).

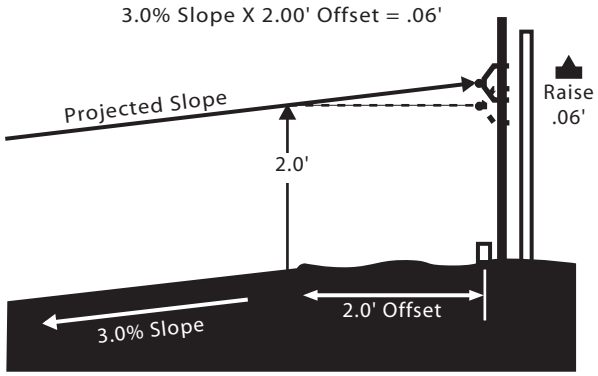

Figure 166: Raise Stringline: 3% Cross Slope with 2 Foot Offset

3. Repeat step 2 for each station.

Verifying Grade

Verifying grade requires measuring the distance from the cut ground to the sonic stringline. To check grade, use a Grade Checking Lath to check the levelness and depth of cut with the sonic stringline.

The following figures show an example of a hub offset of 1.5 feet from the edge of the road, and a hike-up of 2.0 feet.

1. Construct a Grade Checking Lath using a lath, a level bubble, nails, and standard hand tools as shown in Figure 167.

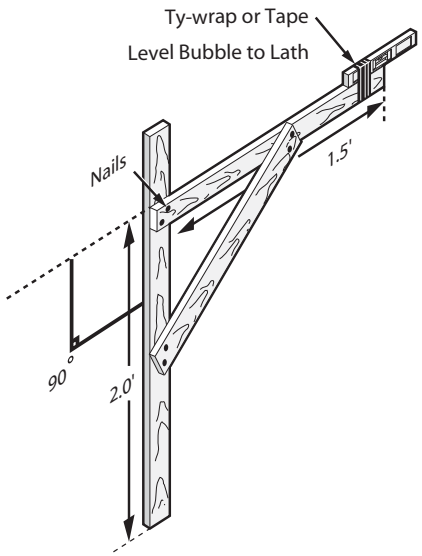

Figure 167: Grade Checking Lath

2. Set the Grade Checking Lath on the edge of the newly cut ground so the level bubble extends over the sonic stringline (Figure 168).

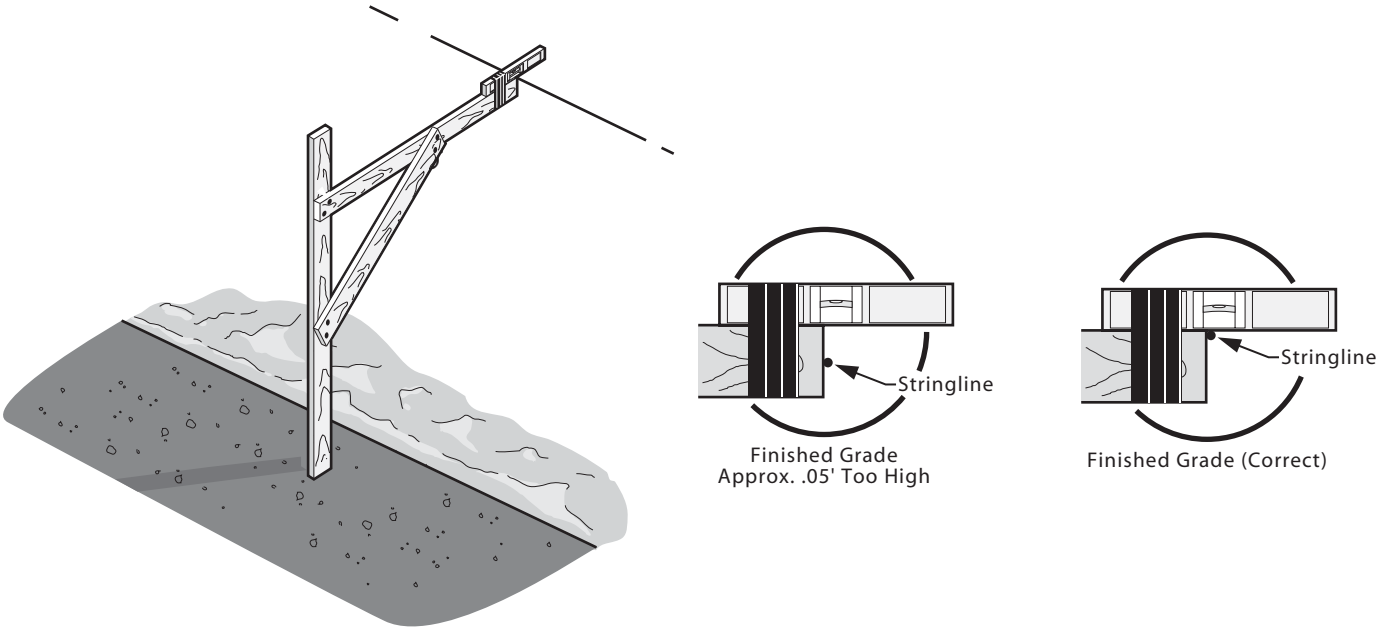

Figure 168: Check Finished Grade

3. Tilt the Grade Checking Lath to center the level bubble. Finished grade is correct if the level just touches the sonic stringline (Figure 168).

This section contains information regarding preventative maintenance and daily care of your Topcon P-32+ or P-32 System. Also included are:

- Cleaning procedures for the Sonic Tracker II Transducer.
- Replacement procedures for the Sonic Tracker II Transducer.

Preventative Maintenance & Daily Care

A good preventative maintenance and daily care routine prevents many problems before they occur. The most important part of daily care for your Topcon P-32+ or P-32 System is to clean it and keep it free of debris, and to thoroughly dry removable components (ST-3/Sonic Tracker II, the Control Box, and cables) before storing them in the Carrying Case. In addition, the following procedures ensure trouble free operation:

1. Keep the Carrying Case clean and dry. Do not leave it open and exposed to the elements. Clean and dry all components prior to placing them into the Carrying Case.
2. Be sure cables left on the paver are attached to protective connector caps, not in use. Water accumulating on the connectors can cause electrical shorts.
3. Do not use high pressure spray water steam cleaner hoses directly on cables and components. The components can be used in the rain or light spraying.
4. Check the Sonic Tracker transducer(s) daily to make sure the transducer(s) are clean and free of debris. See “ST-3 Cleaning” on page 93 and “Sonic Tracker II Transducer Cleaning” on page 94.

ST-3 Cleaning

1. Remove any dirt of debris from the bottom of the ST-3 (Figure 169) by mixing a mild detergent with water and placing the mixture in a spray bottle (use Simple Green® where available).
2. Thoroughly spray the bottom of the ST-3 with the detergent solution and wipe with a soft cloth.
3. After spraying with detergent, fill the spray bottle with clean water and rinse any residual detergent off of the ST-3.
4. Allow the ST-3 to dry.

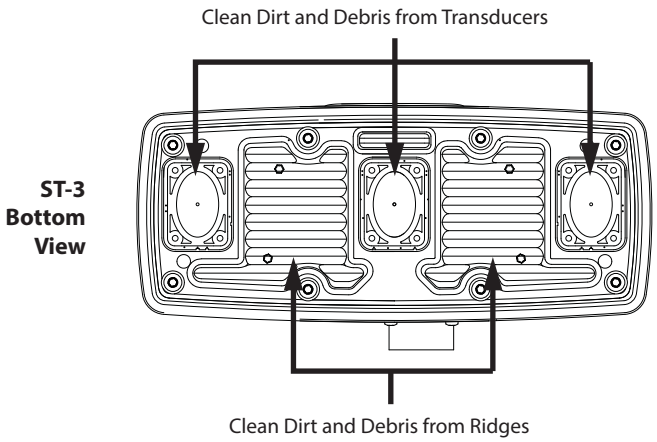

Figure 169: Clean Transducer Area of ST-3

Sonic Tracker II Transducer Cleaning

This procedure is not meant to be a regular maintenance procedure. Clean the Transducer only when contamination is suspected or evident.
Cleaning the transducer too much results in a shortened Transducer life and/or water damage to the Sonic Tracker.

1. Hold the Sonic Tracker II in an upright position to prevent moisture from inadvertently entering the Sonic Tracker.
2. Mix a mild detergent with water and place the mixture in a spray bottle (use Simple Green® where available).
3. With the Sonic Tracker upright, thoroughly spray the Transducer with the detergent solution.
4. After spraying the Transducer with the detergent, fill the spray bottle with clean water and rinse any residual detergent off of the Transducer.
5. Allow the Sonic Tracker to thoroughly dry.

Sonic Tracker II Transducer Replacement

If the ability of the Sonic Tracker II to “see” a sonic stringline or other reference continues to be impaired, the transducer may be damaged and needs replaced.

1. Remove and discard the Filter Foam—a new filter foam is provided in the Transducer Replacement Kit (Figure 170).

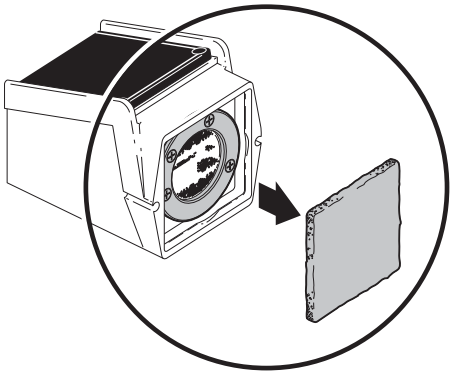

Figure 170: Remove Filter Foam

2. Remove the four screws and the black retaining ring. Remove and discard the “O”-Ring (Figure 171 on page 95).

Always remove and discard used “O”-Rings. Used “O”-Rings are distorted and can loose elasticity due to weather or exposure to diesel fumes.

The Transducer Replacement Kit includes an “O”-Ring and four replacement screws; however, use the original screws and keep the four supplied in the kit for replacements in the event one or more are lost.

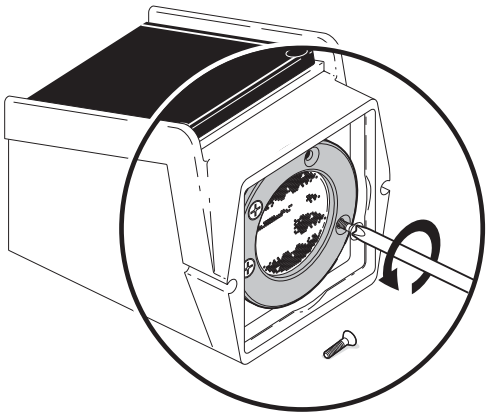

Figure 171: Remove Screws, Retaining Ring, and “O”-ring

3. Gently pull out the transducer and use a SMALL pair of dikes to gently cut the Ty-Wrap, then remove the small wire connectors from their tabs (Figure 172 on page 95).

When cutting the Ty-Wrap, be careful not to cut or damage the wires.

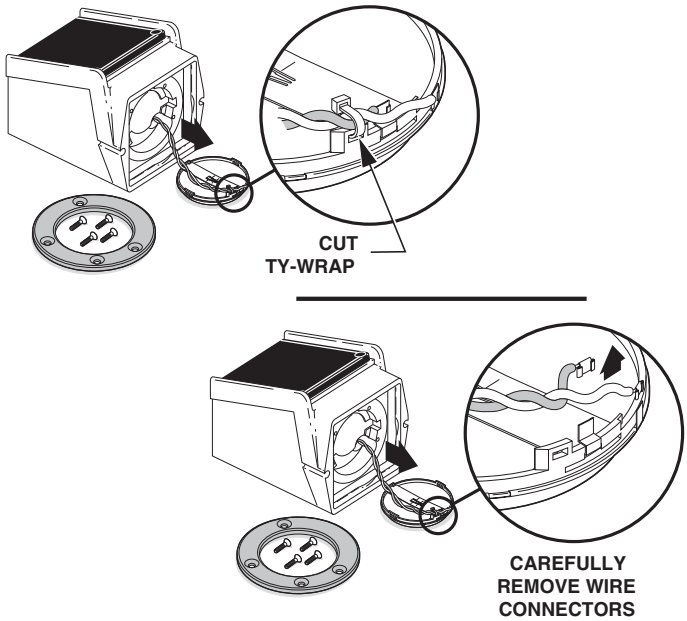

Figure 172: Remove Transducer, Cut Ty-Wrap, and Remove Connectors

4. Place the wire connectors of the new transducer firmly on their tabs; the gray wire connector is placed on the elevated tab. Place the Ty-Wrap in the slot next to the elevated (gray wire) tab, tighten and trim. DO NOT pinch the wires (Figure 173 on page 96).

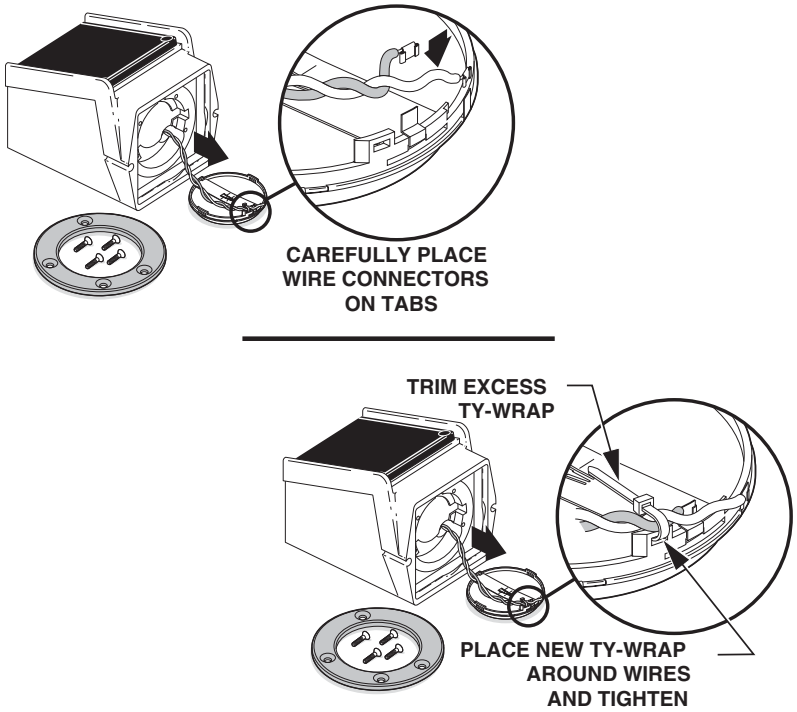

Figure 173: Replace Transducer, Connectors, and Ty-Wrap

5. “Feed” the wires back up into the Sonic Tracker II and seat the transducer into place (the two wire tabs have to sit down into the extra deep area of the recess). Place the new “O”-ring around the transducer and seat firmly between the transducer and the Sonic Tracker II transducer recess (Figure 174 on page 96).

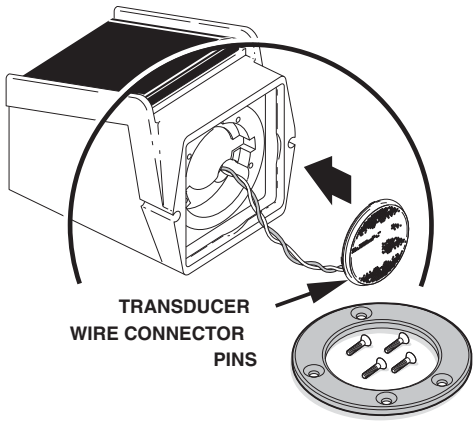

Figure 174: Replace Wires, Transducer, and “O”-ring

6. Place the black retaining ring over the transducer assembly with the beveled edges out and the flat surface against the Sonic Tracker II base. Line up the holes for the mounting screws. The mounting screw holes are set to an irregular pattern, ensuring the retaining ring only lines up with the mounting holes one way (Figure 175 on page 97).
7. Start the mounting screws into the holes and tighten each until firm (Figure 175 on page 97). DO NOT OVER TIGHTEN. Use a cross (X) pattern when tightening the screws.

DO NOT use Loctite® on the mounting screws. Loctite® attacks and degrades the plastic retaining ring.
Over tightening the screws distorts the transducer metallic material and may crack the retaining ring. The O-ring provides tightness while preventing vibration from loosening the mounting screws.

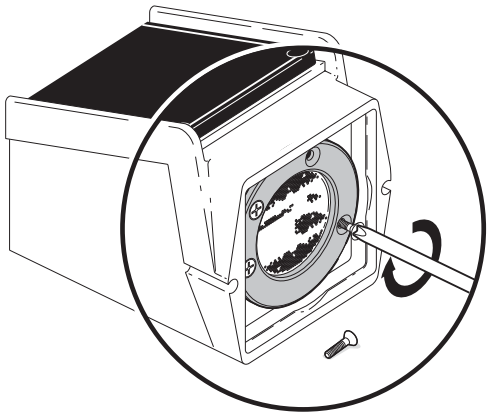

Figure 175: Replace and Tighten Mounting Screws

8. Ensure the metallic surface inside the transducer has no visible wrinkles. If distortion is evident, repeat steps 5 on page 96 to step 8.
9. Place a new filter foam over the transducer. The Sonic Tracker II is now ready for operation.

Control Box Symptoms

1. “The Control Box LCD does not display.”
2. “The Control Box LCD displays Error.”
3. “Cannot adjust to On-Grade when elevation control is selected.”
4. “The tow point cylinder does not move up or down.”
5. “The tow point cylinder is moving in the wrong direction.”
6. “The tow point cylinder is moving too fast or too slow.”
7. “The system intermittently drives the cylinder all the way up or down when tracking a mechanical ski.”
8. “The Control Box SAS icons (numbered 1, 2, 3 or 4) are red.”
9. “The grade lights flash high and low and do not stay On-Grade.”
10. “The valve is driving the hydraulic cylinder too far, overshooting grade.”
11. “The valve does not drive hydraulic cylinder far enough to get sensor On-Grade.”
12. “The Control Box displays red dashes instead of the actual elevation when in elevation mode.”
13. “The Auto light on the Control Box intermittently flashes on and off.”

Control Box Symptom 1

The Control Box LCD does not display.

Probable Cause

No power to the Control Box.

1. Check that the machine power is on and all switches for automatic control on the paver are in the proper position.
2. Check that all cables are properly and securely connected to the Control Box and the paver.
3. Disconnect cables and inspect them for damage or contamination. Clean all connections with an electrical contact cleaner.

Do not use electrical contact cleaner to clean the Tracker's transducer.

4. Swap Control Boxes from left to right side.
5. For System Four™ bypass Junction Box by plugging coil cord from paver to J-Box directly into Control Box.

Control Box Symptom 2

The Control Box LCD displays Error.

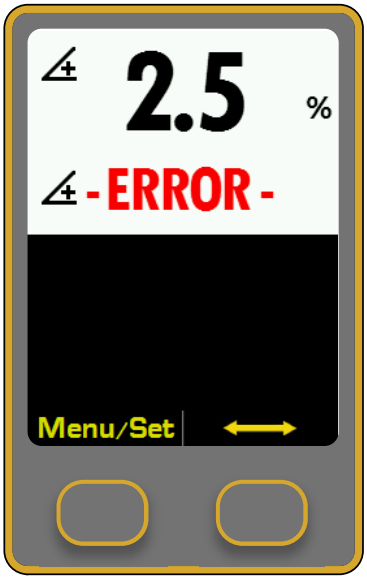

Figure 176: Error Display

Probable Cause

No communication with the sensor selected.

1. Check that all cables are properly connected to the Control Box and sensors.
2. Disconnect cables and inspect them for damage or contamination. Clean all connections with an electrical contact cleaner.

Do not use electrical contact cleaner to clean the Tracker's transducer.

3. If elevation has been selected, one at a time, swap the ST-3 or Sonic Tracker II and cables from the opposite side to locate the error.
4. Refer to Tracker Symptom #1.
5. If slope has been selected, check that slope has not been selected on the other Control Box. Only one box at a time can have slope turned on.
6. Swap slope cable from opposite side.
7. Disconnect cable at Slope Sensor and connect to other side of sensor to check Slope Sensor pins.

Control Box Symptom 3

Cannot adjust to On-Grade when elevation control is selected.

Probable Cause

Tracker is too close to control reference.

1. Check that the ST-3 or Sonic Tracker II is at least 14 inches away from the control reference.
2. Check for unwanted objects within the sonic footprint.

3. Make sure tracker is not positioned in front of a gusty heat source, such as the engine fan exhaust.
4. Stop the paver, make sure the screed is on the ground and turn the vibrators off. Check the sensor readings on the Control Box. Set the display to **+Sensor** or **Both Sides**. See “Display” on page 49.
5. If using a Sonic Tracker II, check for contamination on the Sonic Tracker II transducer or foam filter. Refer to Transducer and Filter Cleaning and replacement information in the Maintenance and Parts section of this manual.
6. Swap the Tracker with the unit on the opposite side.
7. Averaging may be set too low if tracking an uneven reference. Factory setting is 50.

Control Box Symptom 4

The tow point cylinder does not move up or down.

Probable Cause

Machine electrical switches are not in the proper position, or hydraulics to the cylinder are not active.

1. Check that all locking pins have been removed and that all hydraulic blocking valves are in the open and correct position for automatic control. Refer to the paver manufacturer's manual.
2. Check that all machine electrical switches - and in motion circuits are in the correct position for automatic control. Refer to the paver manufacturers manual. Press the jog switch up and down on the Control Box to make sure there is a current going to the valve. Cylinder should move in the same direction the jog switch is pressed.
3. Check that the Auto Switch is in “Auto” and that the Auto Symbol is illuminated on the front panel.
4. Disconnect cables and inspect them for damage or contamination. Clean all connections with an electrical contact cleaner.
5. Swap the Control Box with the unit on the opposite side.
6. If a Control Box is replaced make sure the configuration and performance settings are correct.
7. If a cable is replaced make sure it is the right part number. A cable with the incorrect resistor could set the Control Box to have the wrong configuration.

Control Box Symptom 5

The tow point cylinder is moving in the wrong direction.

Probable Cause

Machine is incorrectly wired or hydraulically connected.

1. Check that the machine is properly wired and hydraulically connected to the valve. A raised jog switch should make the cylinder go up, lowering the jog switch should make the cylinder go down.
2. Check that the proper cables have been supplied for your machine.
3. Make sure the screed lift cylinders are in the float position and not supporting the screed.

Control Box Symptom 6

The tow point cylinder is moving too fast or too slow.

Probable Cause

The paving machine's hydraulic flow adjustment is incorrect, or the Slope Sensor Valve Offsets or Gain Adjustments are not correct.

1. Refer to paver manufacturers recommended flow adjustment setting for the speed of the hydraulics; typically between 12 to 15 seconds.

Moving the cylinder completely up/down on one side can damage the screed.

2. Adjust Gain Performance Settings. The factory setting is 25.
3. Adjust Valve Offsets. Refer to Valve Offset section in the Performance Section within this Manual.

Control Box Symptom 7

The system intermittently drives the cylinder all the way up or down when tracking a mechanical ski.

Probable Cause

Tracker is intermittently picking up signals from the ski.

1. Your valve settings may be incorrect. Check the **Config** number displayed on the **Startup** screen.

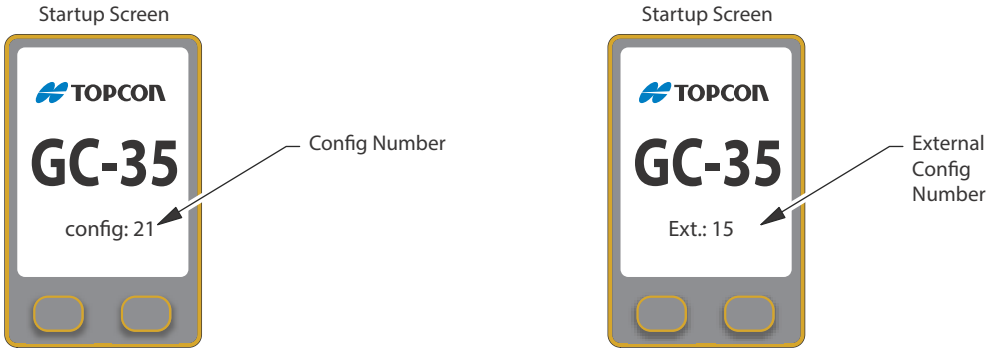

Figure 177: Config Number Located on Startup Screen

Each number represents a specific valve type. The most common numbers are: 21 (sink), **15** (prop. source), and **9** (source). Contact your Topcon support representative and provide the **Config** number to determine if your Control Box is configured with the correct valve setting.

2. Verify string is at least 4 inches above the surface of the ski. The ski pulls away from the paver and can get in Tracker's Working Window if the string is too close. The ski also tilts to one side when traveling through a super elevation or slope transition.
3. For a multi-foot ski, make sure “foot spring pin” is not within the sonic footprint as the ski surges back and forth.

Control Box Symptom 8

The Control Box SAS icons (numbered 1, 2, 3 or 4) are red.

Probable Cause

Defective Sonic Tracker or SAS cable.

1. Check SAS cable connections at each tracker.
2. Turn Control Box off and swap tracker, whose corresponding SAS icon is red (Figure 178), with another tracker on the SAS. (Tracker number is on the cable at the tracker connector). Turn the Control Box on to reset SAS. If any of the SAS icons (1-4) are red, the problem is the tracker. If the SAS icon remains the same, the problem is the SAS cable.

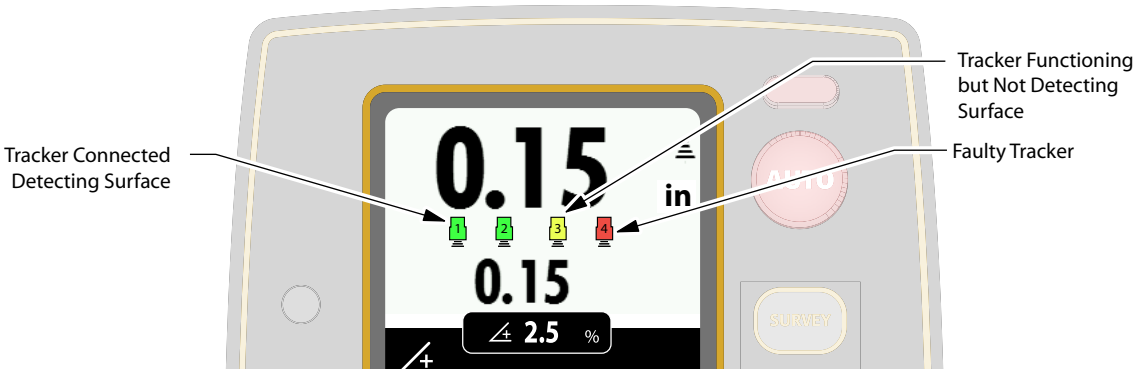

Figure 178: SAS Icons

3. If more than one SAS icon is red, check trackers individually by plugging Slope Sensors directly into the single tracker coil cord to determine if trackers or SAS cable is source of error.
4. The defective tracker or SAS cable should be repaired, but SAS can still be operated without all four trackers. Remember the balance point changes if a tracker is removed.

Control Box Symptom 9

The grade lights flash high and low and do not stay On-Grade.

Probable Cause

If problem is only in automatic mode:

1. Hydraulic Performance Settings my be incorrect.
2. Verify paving machines hydraulic flow adjustments (time for hydraulic cylinder to travel full stroke) are set to manufactures recommendations.
3. Check that the Valve Offsets are set correctly.
4. Check that the Gain setting is too high. Factory setting is 25.

If problem is in manual mode:

1. Verify that temperature bails are clean and securely attached.
2. Verify temperature bail symbol “T” is displayed on face of Tracker. If not clean or replace transducer.
3. Check that Trackers are between 14 and 24 inches from reference.
4. If there are gusty winds, lower Tracker closer to reference. Approximately 14 to 16 inches.
5. Move Tracker away from gusty heat source, such as engine fan exhaust.
6. Verify Tracker is not picking up erroneous signals from undesired reference.
7. Example: Head of material, end gate, shoulder grade or material spillage from hopper.
8. If using Stringline, verify line is not bouncing.
9. Check to see if Averaging in Performance Menu is set too low. Factory setting is 50.
10. Check Deadband in Performance Menu is not less than 3mm.

Control Box Symptom 10

The valve is driving the hydraulic cylinder too far, overshooting grade.

Probable Cause

Valve Offset in Control Box are set too high.

1. Your valve settings may be incorrect. Check the **Config** or **Ext.** (external) number displayed on the **Startup** screen.

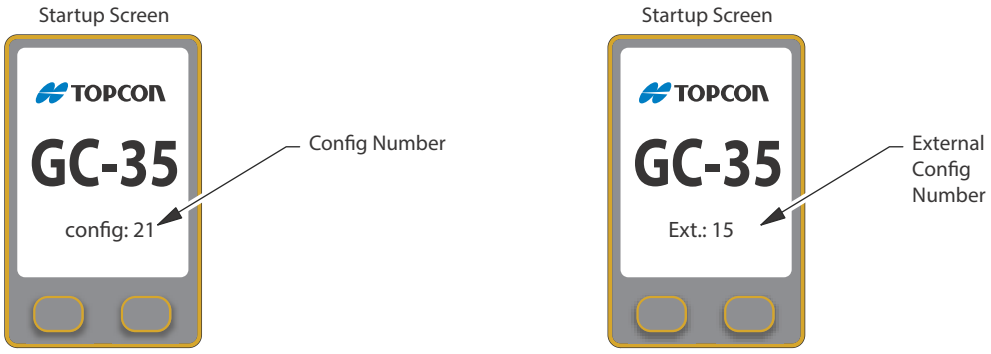

Figure 179: Config/Ext. Number Located on Startup Screen

Each number represents a specific valve type. The most common numbers are: **21** (sink), **15** (prop. source), and **9** (source). Contact your Topcon support representative and provide the **Config/Ext.** number to determine if your Control Box is configured with the correct valve setting.

2. Lower the Valve Offset value until the sensor no longer overshoots grade.
3. “Setting Valve Offsets” section in this manual.
4. For Servo and solenoid valves lower the value by 2 to 5 numbers, then check the hydraulic performance.
5. For Proportional valves, lower the value by 10 to 15 numbers, then check hydraulic performances.

Control Box Symptom 11

The valve does not drive hydraulic cylinder far enough to get sensor On-Grade.

Probable Cause

Valve offsets in Control Box are set too low.

1. Raise the Valve Offset Value till the sensor is driven to grade. Refer to “Setting Valve Offsets” section in this Manual.
2. For Solenoid valves, raise the value by 2 to 5 numbers, then check hydraulic performance.
3. For Proportional valves raise the value by 10 to 15 numbers, then check hydraulic performance.

Control Box Symptom 12

The Control Box displays red dashes instead of the actual elevation when in elevation mode.

Probable Cause

Sonic Tracker is reporting no echo.

1. Verify that the Sonic Tracker is ticking.
2. Make sure tracker is pointing at a target with the working range, recommended 14 to 24 inches.
3. Transducer may be dirty or damaged. Refer to the Transducer and Filter section within this manual.
4. Power or ground connection at transducer may be loose. Remove transducer and check wires.

Control Box Symptom 13

The Auto light on the Control Box intermittently flashes on and off.

Probable Cause

External Auto signal from the machine is preventing control.

1. Check the machine switches.

Sonic Tracker Symptoms

1.	"The Sonic Tracker does not power on."
2.	"The Sonic Tracker is ticking, but does not adjust to grade." **Note: The ticks may not be audible with ST-3. This is normal. ST-3 transducers are not as loud as the transducer in the Sonic Tracker II.**
3.	"The Tracker's grade lights flash high and low and do not stay On-Grade."
4.	"The Sonic Tracker is not matching joint or curb."
5.	"The Sonic Tracker picks up the ground, but does not pick up a stringline."

Tracker Symptom 1

The Sonic Tracker does not power on.

Probable Cause

Defective cable or tracker.

1. Check coil cord is plugged in correctly and securely.
2. Inspect Coil cord for any physical damage.
3. Turn Control Box on and watch the tracker lights to make sure they go through the power up sequence. All the lights on the tracker should flash at once followed by a flash of an arrow pointing to the left. The "T" symbol should also be displayed in the upper right hand corner of the tracker faceplate when a Temperature Bail is attached. If the tracker does not go through this sequence then the tracker is not getting power or is defective.
4. One at a time, swap tracker and then coil cord from opposite side to determine the problem.

Tracker Symptom 2

The Sonic Tracker is ticking, but does not adjust to grade.

Probable Cause

Tracker is too close to reference, minimum working distance is 14 inches.

1. Tracker is too close to reference point. Position tracker 14 to 24 inches from grade reference.
2. Connect tracker to other side of paver to determine if problem stays with tracker.
3. If problem stays with tracker, clean or replace transducer or foam filter. Refer to the Transducer and filter cleaning and replacement information in the "Maintenance" section of this manual.
4. If problem does not move with tracker, inspect coil cord for damage and swap with cord from other side.

Tracker Symptom 3

The Tracker's grade lights flash high and low and do not stay On-Grade.

Probable Cause

If problem is only in Automatic Mode, then Hydraulic Performance Settings are incorrect.

1. Verify paving machines hydraulic flow adjustments, time for hydraulic cylinder to travel full stroke, are set to manufacturers recommendations. Typically 12 to 15 seconds.
2. Check Valve Offsets are set correctly. Refer to setting valve offsets.
3. Make sure Gain Setting is not too high. Factory setting is 25.

If problem exists in manual mode, then Tracker is setup incorrectly or Performance Settings are incorrect.

1. Verify that temperature bails are clean and securely attached.
2. Verify temperature bail symbol "T" is displayed on face of Tracker. If not, clean or replace transducer.
3. Check that Trackers are between 14 and 24 inches from reference.
4. If there are gusty winds, lower Tracker closer to reference. Approximately 14 to 16 inches.
5. Move Tracker away from gusty heat source, such as engine fan exhaust.
6. Verify Tracker is not picking up erroneous signals from undesired reference. Example: Head of material, end gate, shoulder grade or material spillage from hopper.
7. If using Stringline, verify line is not bouncing.
8. Check to see if Averaging in Performance Menu is set too low. Factory setting is 50.
9. Check that Deadband, in Performance Menu, is not less than 3mm.

Tracker Symptom 4

The Sonic Tracker is not matching joint or curb.

Probable Cause

Tracker is too far forward on the tow arm.

1. Position the Tracker at 1/3rd the tow arm length (just in front of auger).
2. Gain for tracker may be set too low. Adjust Gain to a minimum of 25.
3. Brackets and L-bars have not been securely tightened. Also, check for excessive play or slop where tracker is attached to the paver. (Tow arm or end gate.)

Tracker Symptom 5

The Sonic Tracker picks up the ground, but does not pick up a stringline.

Probable Cause

1. Tracker is too close to a reference or transducer is weak.
2. Verify that tracker is at least 14" from the stringline.
3. Smooth, steel wire is not recommended. Use minimum 1/16" diameter string for elevated stringline or averaging ski. Use 1/8" string for Surface Stringline.
4. If using an ST-3, make sure the Sonic Tracker 3 is set to **Stringline** in the Control Box's Performance Menu.

Slope Sensor Symptoms

1.	“Cross Slope displays Error on the Control Box’s Control Screen.”
2.	“Cross Slope drives cylinder in the wrong direction.”
3.	“Slope lights flash between raise and lower and do not stay On-Grade.”
4.	“Cross Slope does not lock On-Grade.”
5.	“The Cross Slope being laid is not correct.”

Slope Sensor Symptom 1

Cross Slope displays Error on the Control Box’s Control Screen.

Probable Cause

Both Control Boxes are selected for slope or have a defective cable.

1. Cross slope operates one side at a time. Verify only one Control Box has been selected for slope.
2. Verify that the slope cable is connected securely and properly.
3. Swap slope cable from other side to check cable.

Slope Sensor Symptom 2

Cross Slope drives cylinder in the wrong direction.

Probable Cause

Slope sensor installed incorrectly.

1. Verify the Slope Sensor is positioned correctly on the transverse beam. “Slope Forward” Decal must be in direction of travel.
2. Check that the machine is properly wired and hydraulically connected to the valve. Raised jog switch should make the cylinder go up, lower jog switch should make the cylinder go down. Refer to the paver manufacturers manual.

Slope Sensor Symptom 3

Slope lights flash between raise and lower and do not stay On-Grade.

Probable Cause

Incorrect Performance Setting adjustments or a loose transverse beam.

1. Check the Valve Offsets for proper operation. See “Valve Offsets (Raise and Lower)” on page 32.
2. Check the Gain settings. Factory setting is 25. See “Elevation Gains (Raise and Lower)” on page 30 and “Slope Gain” on page 31.
3. Slope Deadband set too low. Increase Slope Deadband. The Factory Setting is 0.075%. See “Slope Deadband” on page 34.
4. Check for excess vibration in the Transverse Beam due to poor connection at Tow Arm.
5. Make sure the Slope Sensor is mounted directly to the Transverse Beam and is not elevated or supported by additional brackets.

Slope Sensor Symptom 4

Cross Slope does not lock On-Grade.

Probable Cause

Loose Transverse Beam or incorrect Performance Setting adjustments.

1. Verify that the Slope Sensor is not moving or vibrating when trying to survey slope on grade.
2. Slope Deadband set too low. Increase Slope Deadband. The Factory Setting is 0.075%. See “Slope Deadband” on page 34.
3. Stop the paver, make sure the screed is on the ground and turn the vibrators off.

Slope Sensor Symptom 5

The Cross Slope being laid is not correct.

Probable Cause

Incorrect Slope Sensor calibration.

1. Calibrate the Slope Sensor as described in “Control Box Setup for Slope Control” on page 68.
2. Check that the Transverse Beam is mounted according to the manufacturer’s instructions and that it is not loose or damaged.
3. Recheck slope using a good reference such as a laser or level. Wait at least three tow arm lengths before checking the slope after a change has been made.
4. If you use the paver's mat thickness controls, or hand crank the screed, you may need to adjust the slope calibration to correct any offset between the Slope Sensor and the screed. This can occur after “buying back” cylinder.

SAS Symptoms

1.	When the SAS is connected, Control Box SAS icons display red (“When the SAS is connected, the Control Box SAS icons display red.”
2.	“A Tracker stops working.”
3.	“SAS does not lock on grade.”
4.	“SAS is not producing a smooth surface.”
5.	“A tracker is picking up head of material.”

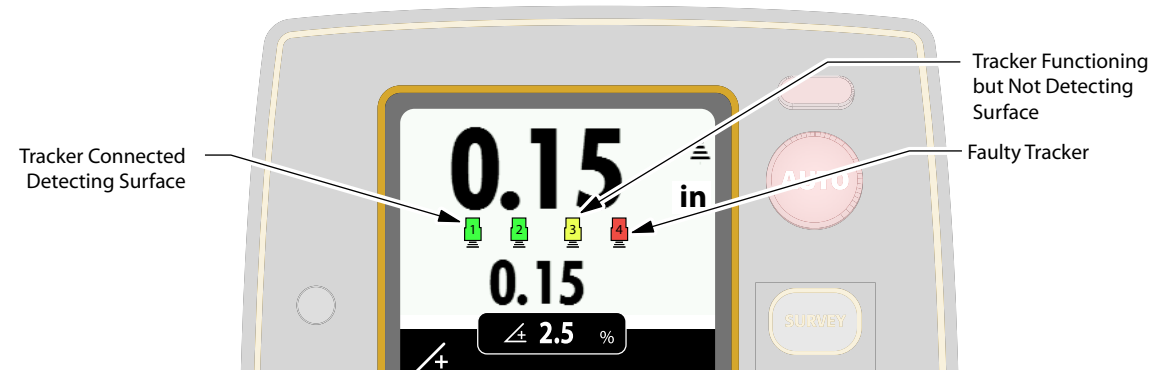

Figure 180: SAS Icons

SAS Symptom 1

When the SAS is connected, the Control Box SAS icons display red.

Probable Cause

Defective tracker or cable, tracker with incorrect code.

1. Verify that all trackers are correctly and securely plugged into the SAS cable by checking the SAS icons on the Control Box (Figure 180 on page 107).
2. Turn Control Box off and move the Tracker to a different position on the SAS cable. Turn the Control Box on to reconfigure SAS. If error number moved positions with the swapped tracker, the tracker is the problem. See Chapter 8 to replace the transducer.
3. Check to see if a Tracker without SAS code is attached to the cable. Verify that the tracker has a SAS compatible decal near the S/N label (Figure 181 on page 108).

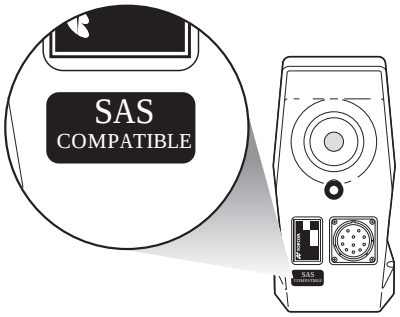

Figure 181: SAS Compatible Decal Location on Sonic Tracker

4. Tracker can also be checked by verifying the code revision.

For the Sonic Tracker II Turn box off and back on. Watch the temperature bail symbol in the top right portion of the tracker (Figure 182). The “T” symbol flashes a certain number of times, pause and flashes again to indicate the revision of its code.

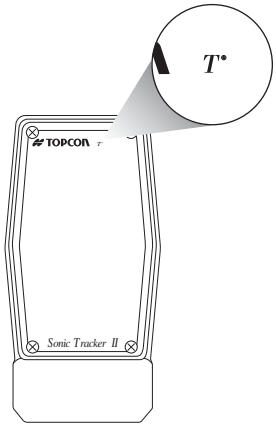

Figure 182: Temperature Bail Symbol Indicating Code Revision

Example: Flash twice, pause flash twice means the code in the Tracker is 2.2. SAS requires trackers with code of 2.2 or higher.

For the Sonic Tracker II From the GC-35 Control Box, check the firmware revision by following the instructions in “System Info” on page 50.

SAS Symptom 2

A Tracker stops working.

Probable Cause

Defective Tracker.

1. Check SAS cable connections at each tracker.
2. Verify the SAS icons on the Control Box. (Figure 180 on page 107)
3. Turn off Control Box and swap tracker showing error with another tracker on the SAS. (Tracker number is on the cable at the tracker connector.) Turn the Control Box back on to reset SAS. If error number moved positions with the swapped tracker, then the tracker is the problem. See Chapter 8 to replace the transducer if necessary.
4. If error continues to display for the same position even after trackers have been swapped, the tracker connector or SAS cable is the problem.
5. The defective tracker or SAS cable should be repaired, but SAS can still be operated without all four trackers operating. Remember balance point changes if a tracker is removed.

SAS Symptom 3

SAS does not lock on grade.

Probable Cause

Tracker too close to reference or defective transducer in Tracker.

1. Verify that all cable connections are properly and securely connected.
2. Verify the SAS icons on the Control Box. (Figure 180 on page 107)
3. Check that all trackers are sending out sound waves (transducer is making ticking sound) and grade lights are flashing.
4. If tracker is not working, check that transducer and foam filter are clean and free from damage. See “Maintenance” on page 88 to replace the transducer if necessary.
5. SAS beam and trackers may be too close to reference. Bottom of tracker must be minimum of 14 inches from reference.
6. You may be using a non-SAS compatible tracker. Verify that the Tracker has SAS compatible decal near the serial number label (Figure 183).

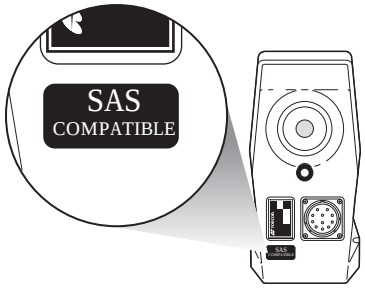

Figure 183: SAS Compatibility Label

SAS Symptom 4

SAS is not producing a smooth surface.

Probable Cause

Improper setup or Performance Menu Settings.

1. Verify that temperature bails are clean and securely attached.
2. Verify temperature bail symbol “T” is displayed on face of Tracker (Sonic Tracker II). If not, clean or replace the transducer. See “Maintenance” on page 88 to clean or replace the transducer if necessary.
3. Check that Trackers are between 14 and 24 inches from reference.
4. If there are gusty winds, lower SAS to get Trackers closer to reference.
5. Move the Tracker away from gusty heat source, such as engine fan exhaust.
6. Verify that the Trackers are not picking up erroneous signals from undesired reference.

   Example: Head of material, end gate shoulder grade or material spillage from hopper.
7. Verify that the center of the SAS beam is between the midpoint and the forward 2/3 point of the tow arm.
8. Check to see if Averaging in Performance Menu is set too low. Factory setting is 50. See “Averaging” on page 32.
9. Check that Deadband in Performance Menu is not less than 3mm. See “Elevation Deadband” on page 33 and “Slope Deadband” on page 34.
10. Check that the Valve Offsets are set properly. “Valve Offsets (Raise and Lower)” on page 32.
11. Check that the Gain setting in the Performance Menu is not set too high. Factory setting is 25. “Elevation Gains (Raise and Lower)” on page 30 and “Slope Gain” on page 31.

SAS Symptom 5

A tracker is picking up head of material.

Probable Cause

Improper placement of Tracker.

1. Move tracker forward of the material. Rotate Tracker to front of bracket or drill a hole in the beam far enough forward to move tracker away from material.
2. Check the balance point. The balance point shifts when moving a tracker.

General Warnings

This product should never be used:

- Without the operator thoroughly understanding this manual.
- After disabling safety systems or altering the product.
- With unauthorized accessories.
- Without proper safeguards at the job site.
- Contrary to applicable laws, rules, and regulations.

TPS products should never be used in dangerous environments. Use in rain or snow for a limited period is permitted.

Tampering with the unit by the operator or non-factory authorized technicians voids the unit's warranty:

- Do not attempt to open the unit and modify any of its internal components.
- Do not short circuit.

Specifications

The following chapter describes the specifications for the main and optional components of the P-32+ and P-32 system.

GC-35

Table 3. GC-35 Specifications

Electrical	
Supply Voltage	10-30 VDC
Supply Current	10.5A max. operating current
Switched Output Power	10A valve output power 5A sensor output power 10A total combined output power
Ports	USB, RS-485, RS-232, CAN (2), Digital input
EMC	Applicable regulation: CE, ISO 13766 FCC Part 15 Subpart B/C ISPRII Class A: 2009 IC: ICES-003/CISPRII Class A: 2009 C-Tick
Physical	
Display	240 x 320 color TFT, enhanced brightness
Housing	Powder coated cast aluminum
Switches	1 ea sealed 32 position rotary encoder w/gold contacts 7 ea momentary push button, elastomer over stainless domes 1 ea sealed latching push button (power)
Connectors	3 ea MIL-C-5015 cylindrical connectors, gold plated contacts, conductive anticorrosive plated housing 1 ea USB
Weight	2.0 lbs
Environmental	
Operating Temperature	-40°C to +80°C (-40°F to 176°F)
Moisture	240 Hours
Shock	50G 11 ms ½ sine wave each axis
Vibration	10-400 Hz sweep 5G, 1 oct/min; 10-400 Hz random 5G each axis
Salt Fog Test	48 hours (ASTM B117-97)
Valve Outputs (One Valve Output; One Bidirectional Hydraulic Cylinder)	
Current Controlled Proportional Mode	7.4 V, 5000 mAh

Table 3. GC-35 Specifications

Pulse Width Modulated Proportional Mode	1-13, 225-1950 Hz programmable Programmable dither 0-105 Hz, 0-15% Programmable current limit Sink or source operation
Solenoid (On/Off) Mode	1-13, 225-1950 Hz programmable Programmable dither 0-105 Hz, 0-15% Programmable current limit Sink or source operation
Danfoss™ Proportional Mode	50% available voltage as neutral >50%=Raise, <50%=Lower Programmable dither 0-105 Hz, 0-15

ST-3 (P-32+ System Only)

Table 4. GC-35 Specifications

Electrical	
Resolution	.0025 ft
Supply Voltage	10-32 VDC
Supply Current	300mA typical operating current
Emissions	FCC Part 15, Subpart B Class A/CISPR 11ISO 13766/EN 13309
Immunity	ISO 13766 for radiated RF immunity and ESD
Transducer Frequency	50kHz burst
Target Range	14 in to 36 in
Detection Zone	9 in x 6 in at 2 ft - Stringline mode 8 in x 6 in at 2 ft - Surface mode
Physical	
Display LEDs	1 ea. Status 11 ea. Left/Right/Centered - Stringline mode Raise/Lower/Ongrade - Surface mode
Housing	Powder coated cast aluminum
Switches	1 ea sealed 32 position rotary encoder w/gold contacts 7 ea momentary push button, elastomer over stainless domes 1 ea sealed latching push button (power)
Connector	11 pin bayonet/shell size 18
Weight	3.0 lbs
Environmental	
Operating Temperature	0°C to +80°C (32°F to 176°F)
Storage Temperature	-40°C to 100°C (-40°F to 212°F)

Table 4. GC-35 Specifications

Ingress Protection	IP-67 IP-69K
Vibration	Random 10-2000Hz, 10Grms, 30 min per axis
Shock	Drop from 500mm, faces and edges 50G saw-tooth 6ms, 600 total
Hot Start	80°C (176°F)
Cold Start	-40°C (-40°F)
Temperature / Humidity Cycle	-20°C to 60°C (-4°F to 140°F), 95% R.H. 30 cycles
Temperature Shock	-40°C to 80°C (-40°F to 176°F), 12 cycles
Humidity	96%R.H. at 40°C, 10 days
Salt Fog	5%NaCl, 48 hours
UV	300 hours
Chemical	Diesel, hydraulic oil, ethylene glycol
Compatibility	
• Sonic Tracker II (9142) Connector/Cable • GC-35 Control Box (9259) using Stringline Mode and Surface Mode • All other Topcon Control Boxes using Surface Mode Only	

Sonic Tracker II (P-32 System Only)

Table 5. Sonic Tracker II Specifications

Electrical	
Resolution	.0025 ft
Supply Voltage	10-32 VDC
Supply Current	200mA typical operating current
Emissions	Applicable regulation: EN55022:1994 30-230MHz 40dB (mV/m) Max at 10m 230-1000MHz 47dB (mV/m) Max at 10m
Immunity	Applicable regulation: EN50082-1:1992 ESD: ±8KV RF: 27 to 500MHz 3V/m Fast transient: ±0.5KV capacitively coupled
Transducer Frequency	50kHz burst / 40Hz max rep rate
Cone Size	6 in minimum diameter at 2 ft

Table 5. Sonic Tracker II Specifications

Working Window (Adjustable)	Patented #4733355 Coarse: 0.15ft (4.5cm) Fine: 0.05ft (1.52cm) Ongrade: Adjustable
Physical	
Display LEDs	1 ea. Bail 11 ea. Raise/Lower/Ongrade
Housing	Powder coated cast aluminum
Connector	11 pin bayonet/shell size 18
Weight	2.0 lbs
Environmental	
Operating Temperature	0°C (32°F) to +60°C (140°F)
Vibration	5G 0 to 100Hz any axis

Dual Port Slope Sensor

Table 6. Dual Port Slope Sensor Specifications

Electrical	
Resolution	+/- 0.025% slope High resolution mode +/- 0.00625% slope
Supply Voltage	10-30 VDC
Supply Current	85mA typical operating current
Emissions	Applicable regulation: EN55022:1994 30-230MHz 40dB (mV/m) Max at 10m2 30-1000MHz 47dB (mV/m) Max at 10m
Immunity	Applicable regulation: EN55024 ESD: +/- 8KV RF: 27 to 500MHz 3V/m Fast transient: +/- 0.5KV capacitively coupled
Range	+/- 0-20% slope
Network	Topcon proprietary RS-485 network port
Physical	
Display LEDs	1 ea. Status (bi-color yellow/green)
Housing	Powder coated cast aluminum

Table 6. Dual Port Slope Sensor Specifications

Connector	MIL-C-5015 cylindrical connectors Silver plated contacts Conductive anti-corrosive coating 2 ea. 10 pin screw
Environmental	
Operating Temperature	-20°C to +60°C (-4°F to 140°F)
Vibration	5-100Hz sweep 5G all axis
Shock	Half sine 11ms, 50G all axis
Moisture	MIL STD 810D method 506 95% humidity at 60° soak

LS-B110 Laser Receiver (Optional)

Table 7. LS-B110 Laser Receiver Specifications

Electrical	
Detector Angle	360°
Detector Range	250mm (6.8in)
Detective Precision	Mode1: ±3mm (0.009ft) Mode2: ±6mm (0.019ft) Mode3: ±15mm (0.049ft) Mode4: ±30mm (0.098ft)
External Power Supply	10-30 VDC
Internal Battery	C-size dry cells 4 pcs. Battery pack BT-68Q (sold separately)
Continuous Operating Time	Approx. 80 hours (using alkaline manganese dry cells) Approx. 40 hours (using battery pack BT-68Q)
Immunity	Applicable regulation: EN55022 Class A
Wireless communication	20m RD-100W
Physical	
Display LEDs	On-Grade Zone: 0.08, 0.24, 0.47, 1.18 inches, 2, 6, 12, 30 mm LED Grade Indicators: Red (up arrow), Green (–), Red (down arrow) LED Grade Patterns: 5 grade, 2 lost beam, 1 low battery, 1 level alert
Housing	ABS
Dimensions	158mm x 166mm x 357mm (6.2in x 6.5in x 14.0in) (with mechanical clamp)
Weight (without cells)	2.0kg (4.4lbs)
Mounting	built-in magnet mount, grade rod clamp attachment
Buttons	3 ea. (1 power, 1 mode,1 beeper)
Beeper	Dual tone (loud and soft)

Table 7. LS-B110 Laser Receiver Specifications

Environmental	
Operating Temperature	-20°C to +50°C (-4°F to 122°F)
Storage Temperature	-30°C to +60°C (-22°F to 140°F)
Humidity	95% 40°C 48H
Vibration	JIS A 8101
Shock	Half Sine 11ms, 50G All Axis
Ingress Protection	IP66

9130 Laser Receiver (Optional)

Table 8. 9130 Laser Receiver Specifications

Electrical	
Detector Angle	360°
Detector Window	3 ea. 140mm (5.5in)
Supply Current	0.2A Typical operating current
Supply Voltage	10-30 VDC
Emissions	Applicable regulation: EN50081-1:1992 30-230MHz 40.0dB (mV/m) Max at 10m 230-1000MHz 47.0dB (mV/m) Max at 10m
Immunity	Applicable regulation: EN50082-1:1992 ESD: ±8KV RF: 27-500MHz 3 V/m Fast transient: ±0.5KV capacitively coupled
Physical	
Display LEDs	Raise/Lower/On-Grade
Housing	Cast aluminum, polycarbonate
Dimensions	Ø96.5mm x 166mm x 254mm (Ø3.8in x 6.5in x 10.0in) (with connector attached)
Connector	18-11 bayonet
Environmental	
Operating Temperature	-0°C to +60°C (30°F to 140°F)
Valve Outputs	
PWM (Sink/Source) Solenoid (Sink/Source) Servo	

The following sections provide information on this product's compliance with government regulations for use.

Federal Communications Commission (FCC)

The product described in this manual is in compliance with the Federal Communications Commission directives from the United States of America.

- FCC Part 15 Subpart B/C ISPRII Class A: 2009

Industry Canada Compliance (IC)

This class A digital apparatus complies with Canadian IC: ICES-003/CISPRII Class A: 2009.
Cet appareil numérique de la classe A est conforme à la norme ICES-003/CISPRII du Canada.

Community of Europe (CE)

The product described in this manual is in compliance with the EMC directives from the European Community.

- EN 300 440-2 V1.4.1

The following CE mark is affixed to the device: CE

Australian Communications and Media Authority Compliance (ACMA)

The product described in this manual is in compliance with the EMC directives from the Australian Communications and Media Authority.

- C-Tick N 13813

The following C-Tick mark is affixed to the device: N 13813

WEEE Directive

Following information is for EU-member states only:

The use of the symbol below indicates that this product may not be treated as household waste. By ensuring this product is disposed of correctly, to help prevent potential negative consequences for the environment and human health, which could otherwise be caused by inappropriate waste handling of this product. For more detailed information about the take-back and recycling of this product, please contact a supplier where you purchased the product or consult.

Warranty

Topcon laser and electronic positioning equipment are guaranteed against defective material and workmanship under normal use and application consistent with this Manual. The equipment is guaranteed for the period indicated, on the warranty card accompanying the product, starting from the date that the product is sold to the original purchaser by Topcon's Authorized Dealers.[1]

During the warranty period, Topcon will, at its option, repair or replace this product at no additional charge. Repair parts and replacement products will be furnished on an exchange basis and will be either reconditioned or new. This limited warranty does not include service to repair damage to the product resulting from an accident, disaster, misuses, abuse or modification of the product.

Warranty service may be obtained from an authorized Topcon warranty service dealer. If this product is delivered by mail, purchaser agrees to insure the product or assume the risk of loss or damage in transit, to prepay shipping charges to the warranty service location and to use the original shipping container or equivalent. A letter should accompany the package furnishing a description of the problem and/or defect.

The purchaser's sole remedy shall be replacement as provided above. In no event shall Topcon be liable for any damages or other claim including any claim for lost profits, lost savings or other incidental or consequential damages arising out of the use of, or inability to use, the product.

1. The warranty against defects in a Topcon battery, charger, or cable is 90 days.

Glossary

A

Aggregate

Various hard, inert materials such as sand, gravel, pebbles, etc. used as the bulk material in asphaltic mixes.

Angle of Attack

The angle that exists between the bottom of the screed and the grade over which the screed is traveling.

Auger

The broad, spiral flange on a screed which rotates and spreads paving material evenly in front of the screed.

Auger Shadows

The dark and light areas along the length of a mat surface caused by the compaction of materials having different densities and textures.

Automatic Feed Controls

The dual feed system on a paving machine used to maintain a constant head of material in front of the screed.

Automatic Grade and Slope Controls

Sensing equipment used on paving machines to set and maintain proper elevations and percent slope. The Topcon P-32 System provides paver operators with automatic grade and slope control.

B

Bitumen

A thick, viscous, petroleum-based substance used as a bonding agent in asphaltic mixes.

Bail

A wire frame added to the Tracker that acts as a fixed target to compensate for rapid air temperature changes.

C

Calibration

Setting the elevation reading or Slope Sensor reading to match the actual position of the screed.

Compaction

To press tightly, thereby increasing the density of paving material.

Cone

Pattern of distribution of the Sonic Tracker II sound waves. The sound waves leave the Tracker in a circular pattern that gets wider as it gets further from the Tracker.

Conveyor

The assembly used to move paving material from the hopper to the auger.

Cross Slope

The angle of slope required to produce a desired surface slope. Cross slope is measured in percent.

Crown

The transverse contour of a finished mat.

The contour of the screed plate.

The transition line between 2 different slopes (i.e. between lanes or between lanes and shoulders).

Lead Crown

The contour or profile from side to side of the leading edge of the screed.

Negative Crown

Contour which is higher at the edges than at the center of a mat.

Positive Crown

Contour which is higher at the center than at the edges of a mat.

Tail (Road) Crown

The contour of the trailing edge of the screed.

Cut-off Shoe

A detachable plate used to reduce the paving width of a screed.

D

Density

Compactness of paving material.

E

Edger Plate

A vertical plate at each end of the screed used to confine the head of material.

Elevation

The vertical height or depth of the surface being laid. Elevation is measured in centimeters, inches, or feet.

F

Feeders

The auger-conveyors on the right and left hand sides of a paving machine.

G

Grade

The base surface (road bed) over which paving is being laid.

The elevation of a fresh mat in relation to the base.

The incline of a paving surface in the direction of travel, expressed by stating the rise or fall as a percent age of horizontal distance.

(i.e., 6% grade = 6' of elevation change in 100' of horizontal longitudinal run).

Grade Control

A means of controlling the elevation of a mat as it is being laid.

Grade Sensor

An electric device which detects positive and negative changes in elevation from a grade reference (i.e., surface string, floating beam, mat reference, adjacent mat or curb surface).

H

Head of Material

The volume of paving material directly in front of and across the entire length of the screed.

Hopper

The area at the front of the paving machine which receives the paving material.

Hydraulic

Liquid in motion under pressure, the flow of which causes work to be accomplished.

Hydrostatic Transmission

Power transmitted by a positive displacement pump through a liquid under pressure to a positive displacement motor.

I

Inclinometer

See Slope Sensor

J

Joint Matcher

See Automatic Level Control

L

LCD

Liquid crystal display. LCD is used in the display window on the Control Box to show numbers and symbols for Paver control functions.

LED

Light Emitting Diode. These are the red lights seen on the faces of the Control Box, ST-3, Sonic Tracker II and Laser Tracker.

Line of Shear

The lateral line of contact in the paving material at the leading edge of the screed pre-strike-off where material divides to pass beneath the screed plate or moves upward along the face of the screed into the augured material for later placement.

M

Mat

The material being placed by a paver/finisher.

N

Null

A condition which exists when components are at rest.

"Null" Screed

A screed resting flat on the mat and having no angle of attack.

O

On-Grade

When a surface is at the desired elevation or slope, it is referred to as being On-Grade.

Overlay

Paving over an existing mat.

P

Paddle Box

The sensing device used with automatic feed control to measure and control the head of material.

Percent (%) Slope

The unit of measure used for cross slope.

Pull Points

See Tow Points

Push Roller

Rollers mounted at the front of the paver to control the contact area between he paver and the asphalt truck tires.

Q

Quarter Points

Points on the screed midway between the center and the ends.

R

Ripples

Short frequent changes in the elevation of a mat surface.

S

Screed

The assembly behind the tractor. The screed strikes off, smooths and compacts the paving material into a semi-finished mat.

Screed Extensions

Attachments for increasing screed width.

Screed Heaters (Burners)

Devices which preheat the screed plate to a temperature approximately that of the material to be laid.

Screed Plate

The bottom plate of the screed.

Slope

The incline of a paving surface perpendicular to the direction of travel expressed by stating the rise or fall of a percentage of horizontal distance (i.e. 2% slope = 2" of elevation change in 100" of lateral run).

Slope Control

A means for controlling the transverse elevation of the fresh laid mat in relation to the grade.

Slope Sensor

An electrical device which detects positive and negative change in lateral elevation using the grade controlled side of the machine as a reference.

Survey

Function used to show the current elevation when in CAL mode. Also used in Laser Tracker operations in conjunction with he Enter Button to move the Tracker receiver up and down.

T

Thickness Control Screws

The adjusting crank located at the rear of each side arm, used to control the angle of attack of the screed.

Tow Points (Pull Points)

The points where the side arms of the screed are attached to the Tractor unit.

Transverse Beam

A steel bar connected to the side arms of a screed for mounting the Slope Sensor.

Temperature Bail™

A wire frame added to the Tracker that acts as a fixed target to compensate for rapid air temperature changes.

V

Vibrators

A rotating shaft and eccentric weight assembly mounted on the screed that produces vibration.

W

Wave

Long repeating changes in the elevation of the mat surface.

Working Window

Adjustable region of measurement used by the Sonic Tracker II to determine if elevation correction is required.

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P-32+ and P-32 System Operator's Manual

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